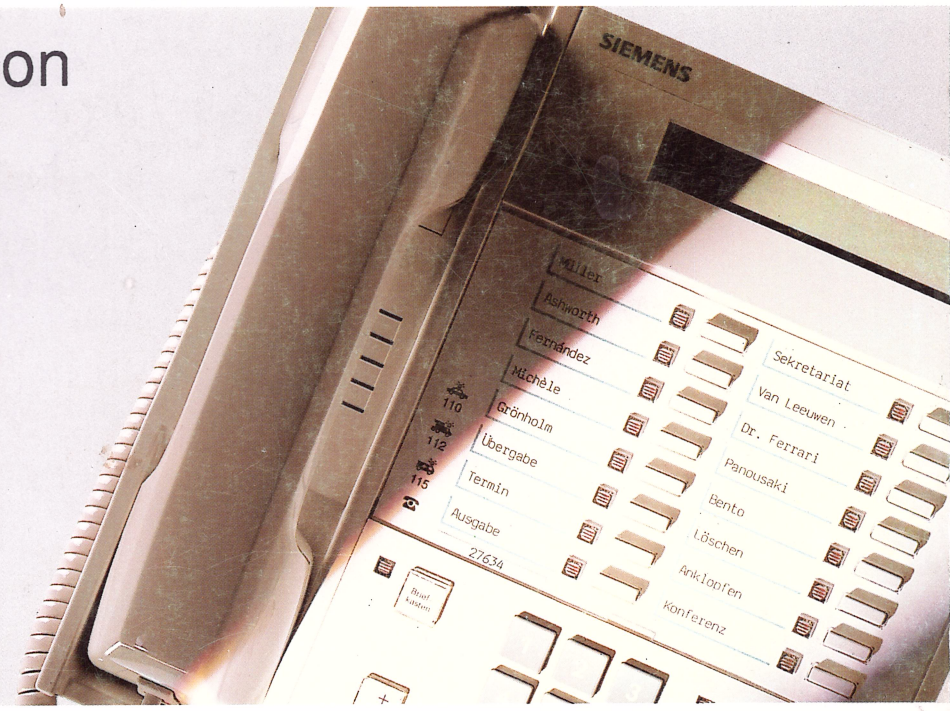
SIEMENS

Hicom 300

General description



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Contents

ISDN and Hicom® 300

Hicom 300 System

Figures

ISDN and Hicom 300

A ISDN technology for future office communication requirements

As a result of rapid advances in the field of electronics, it became economically feasible to introduce transmission systems based on PCM technology in the early 1970s. A fundamental factor in the worldwide introduction of PCM was CCITT's recommendation of a bit rate of 64 kbit/s per channel. In view of the trend toward digitization of telephone networks, this is an ideal prerequisite for the integration of all telecommunications services (voice, text, data, image) into one network, the

ISDN – Integrated Services Digital Network.

The principles and standards on which the ISDN is based can be used to particular effect in the business sector, whether in the local area of an ISDN communication system or in a private digital network.

Previously, the different transmission and switching systems used in a variety of networks, and the broad range of largely incompatible terminal equipment, resulted in a considerable amount of unnecessary expenditure. The communications networks formed "communication islands" each with its individual characteristics. A user required several lines for the different services, and combined access to services was both difficult and expensive.

Numerous workstations in the office already have word processors, desk-top computers or powerful video display units in addition to straightforward or more sophisticated telephone sets. These stations should all be able to communicate not only with one another but also with computers, data bases and printers. Moreover, different forms of communication should be possible from the one workstation - whether they are activated in parallel, alternately or simultaneously. The aim, therefore is to achieve *mixed-mode communications*.

With the rapidly increasing demand for mixed-mode communications in the office sector it is clearly advisable to digitize future transmission and switching sytems on a standard basis. Interconnection of the different types of equipment and the standardization and integration of the communications systems and networks are goals which must be pursued as a matter of urgency.

An ISDN communication system links all terminals and office systems internally, permits so-called mixed-mode communication and provides the interface to public communication networks.

The trend toward office communication with ISDN has the following advantages:

- Standardization of the interface and architecture of user access in the form of digital multi-channel connection, with high transmission capacity on a pair of connecting wires
- Utilization of the existing copper cable network – which is now a global network with the ability to reach every office – on the basis of all-digital connections
- Ability to access a user's voice, text, and data terminals under a single call number and with service-related handling procedures, whether the terminals are individual units or multi-terminals
- Standardization of a universal medium of transmission and transport, with the addition of such services as are required, to form a universal communications system
- Initial standardization of service and network interworking
- Comprehensive range of services:
  - **Standard services**, such as qualitatively improved and more convenient telephony, teletex, facsimile, etc.;
  - **Transmission services**, such as circuit-switched and packet-switched data communication services;
  - **Higher-level services**, (so-called Value Added Services) such as PC mail, voice mail and text mail;
  - **Special services**, including alarm and emergency services, telemetering, and telecontrol.

ISDN will also provide the transition from present-day to future services on the basis of existing interfaces and others which have yet to be standardized. Interworking functions, i.e. devices which allow traffic between otherwise incompatible services, will increase ISDN's potential even further.

B ISDN Communication System Hicom 300

The demand for a broad range of peripheral and functional facilities with a high degree of modularity and expandability led to the development of the Hicom 300 ISDN communication system. Hicom brings together existing communication methods in digital, service-integrating private branch exchanges. All its operating functions are software-controlled.

Three of the system's features deserve special mention :

- Integration of circuit switching and store-and-forward switching functions for voice, text, data, and image communication.
- All switching functions are performed on a digital basis for all forms of communication.
- Because of its hardware and software architecture the Hicom 300 communications system can be adapted to suit future service features and/or technologies; it constitutes the basic system which is geared to all possible innovations.

The Hicom 300 system incorporates the features of present-day telephone PABXs and of new integrated voice/data PABXs.

It also offers the following ISDN features:

- Support of the standard ISDN interfaces to the lines and to the terminal units, in the case of connection via basic access resp.primary multiplex access.
- Features for the standard ISDN services;
- Higher-level services which are needed if the ISDN concept is to be applied usefully to the requirements of future office automation: printing, mailbox, archiving services, etc.

These ISDN functions require:

- Standard processing of all forms of communication, such as voice, text, image, data,
- Not only switching facilities, but also storage and processing of information as well as store-and-forward functions for voice, text, images and data.

And more specifically,

- Personalized call numbers, with facilities for users to transfer their own station data to various other lines by means of chip card identification,
- Combination of several terminals for different services under a single number,
- Service-related connection handling, e.g. supervision of terminal compatibility,
- Facilities for mixed-mode communication. With the two information channels at his disposal, each user can communicate via two media at the same time (e.g. speech accompanied by facsimile).

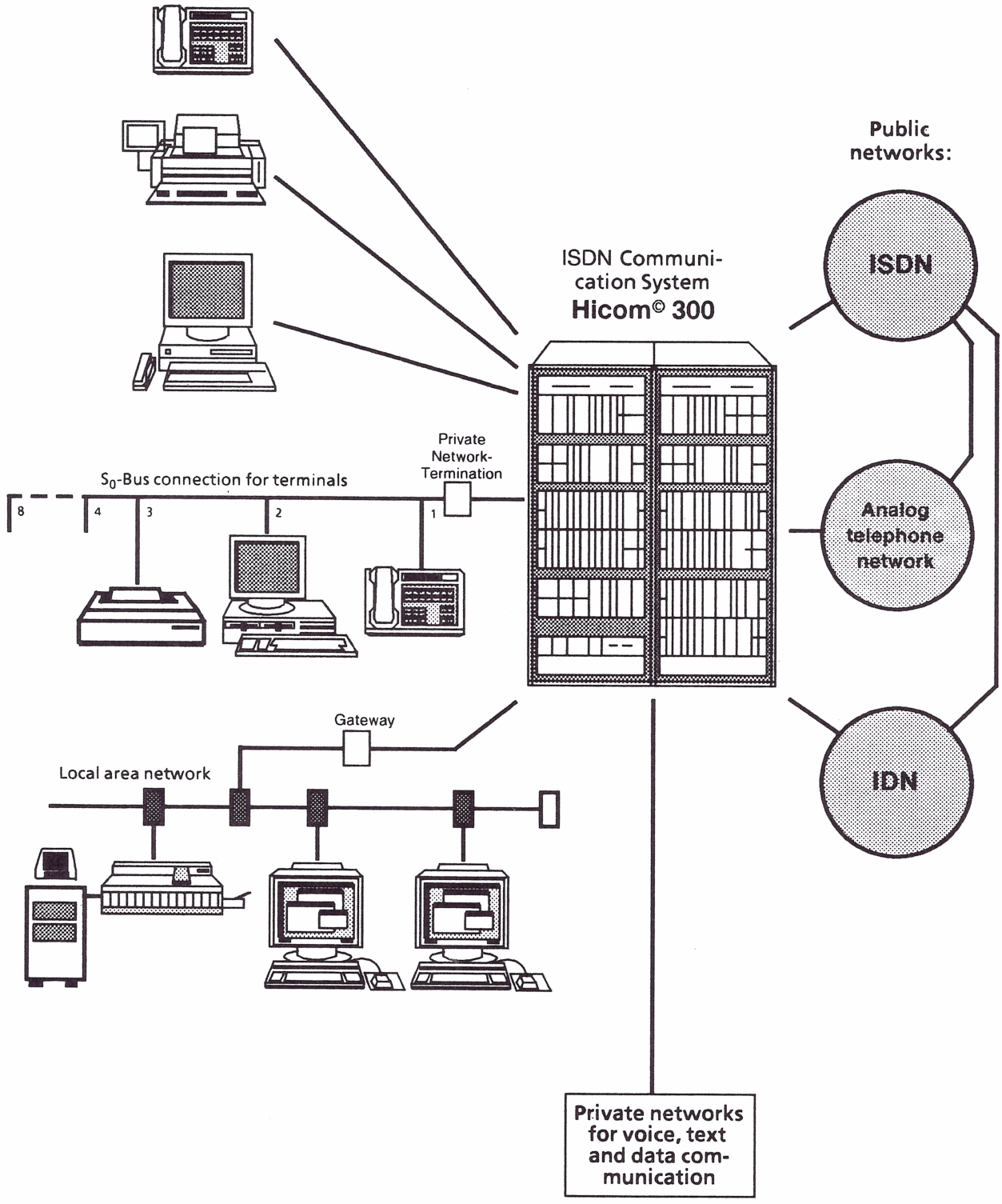
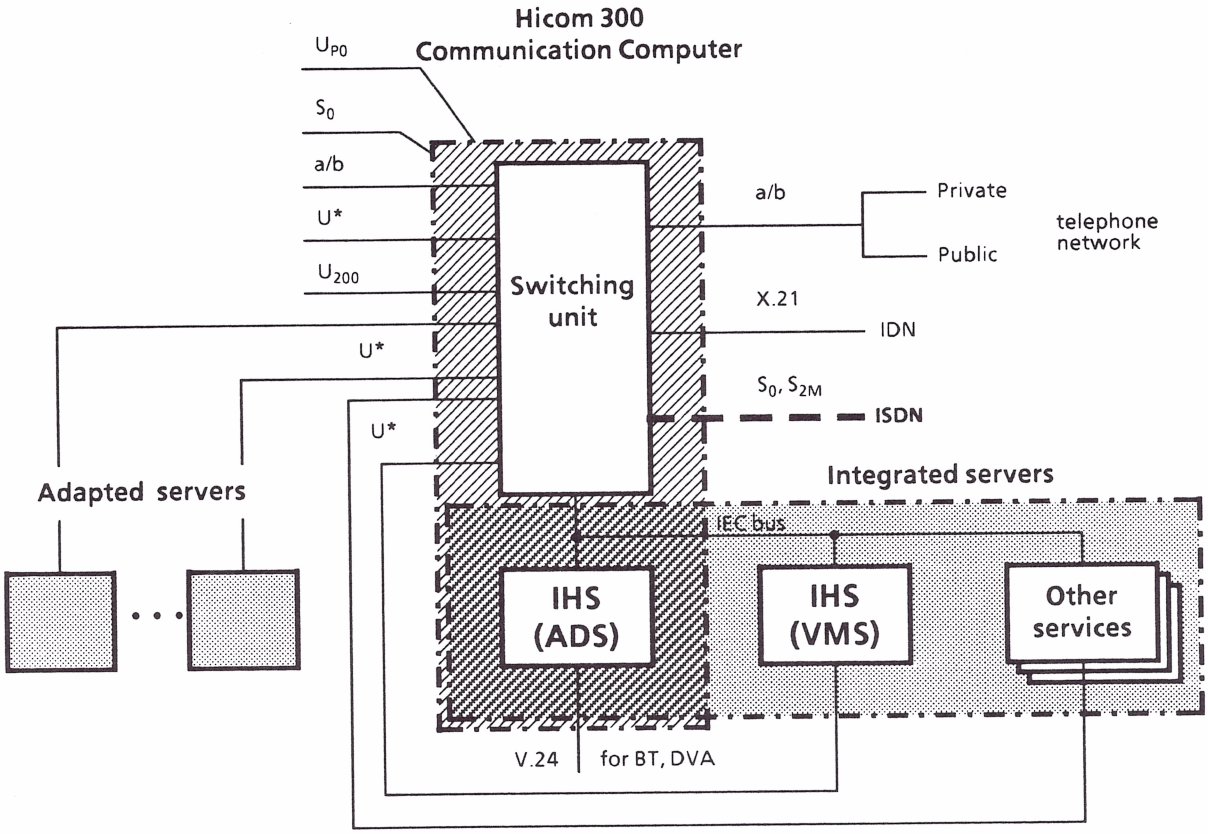


Fig. B-1: Incorporation of the ISDN Communication System Hicom 300 in present and future networks and examples of compatible terminal devices

B1 Structure of the Hicom 300 System

The Hicom 300 ISDN communication system comprises three essential function blocks: the switching unit, integrated servers, and adapted servers. The main task of the switching unit is to set up and clear down single or multiple connections for the purpose of information transfer; the servers provide functions which enable information to be buffered and processed.



IHS Integrated Hicom server
ADS Administration and data service
VMS Voice mail service
BT Service terminal

Fig. B1-1: Block diagram of the Hicom 300 Communication System

The *communication computer* of the Hicom 300 ISDN communication system comprises

- **Switching unit** for the call processing functions
  The switching unit implements all the features for message communication (via circuit-switching or in future packet-switching) and serves all interfaces to the switching environment and to the terminal units, attendant consoles and circuits /gateways to other networks.
- **Integrated Hicom servers IHS (ADS)**
  The administration and data service is the administrative center of the ISDN communication system, serving all the devices needed for the tasks of administration and maintenance. It also allows the data channel to be connected to a host computer.

There are specific servers for higher-level information processing, such as

- store-and-forward features for voice, text, images, data,
- processing functions in connection with text communication services,
- industry-specific and general application programs
  (closely linked to the wide-ranging communications functions of the system).

A distinction is drawn between *integrated* and *adapted servers*.

- **Integrated servers** are expansions of the communication computer – on the basis of the same hardware and software – for mailbox and store-and-forward features. Structural and functional integration with the communication computer means that there is a straightforward, uniform user interface for the numerous circuit-switching and store-and-forward functions. Functional integration is achieved by way of a system bus (IEC bus) and the U* interface.
- **Adapted servers** are used for processing and filing both text and data. They too are optional expansions of the communication computer. This type of independent server interoperates with the communication computer in a system network via U* or a/b station lines.

Depending on the number of ports connected, the Hicom 300 communication system is subdivided into three capacity stages:
Hicom 300 comprising ≤256 ports
Hicom 300 comprising ≤960 ports
Hicom 300 comprising ≤5120ports

Specific software facilities enable each circuit of a module to be blocked or deblocked. Thus the capacity of a system is continuously adjustable through its ports within preset limits.

The above subdivision chiefly effects the architecture of the switching unit, whose centralized functional units - the switching network and the controller - are designed in the same technology on a modular basis.

As far as the servers are concerned, larger-size systems are implemented by using a number of units of the same type.

The Hicom 300 ISDN communication systems has a broad range of interfaces which enable it to interoperate with various networks and a variety of peripheral devices:

- **a/b interface**
  These interfaces connect analog devices and handle services via modems. On the network side trunk lines of public and private networks are connected which operate with the HKZ and IKZ signaling systems.
- **U* interface**
  This interface, the digital multi-channel interface, is used to operate multifunction devices such as multiterminals and servers.
- **U_{200} interface**
  The U_{200} interface is used to operate digital voice terminals, the switching terminal, and data terminals with V.24 interfaces via Hicom adapter DCI.
- **S_0/S_{2M} interface**
  The public ISDN is connected to the S_0/S_{2M} interface.

  Implementation of the CorNet-N protocol permits convenient networking of Hicom 300 Systems.
- **U_{P0} interface** (see Fig. B1-2)
  For connection of a PNT with S_0 bus, or Hicom set 500 with PNT 520
- **S_0 interface/S_0 bus** (see Fig. B1-2)
  Direct connection of ISDN terminals (e.g. Hicom set 700) to the S_0 bus,
  Connection of terminals with conventional interfaces via Hicom adapters DCI

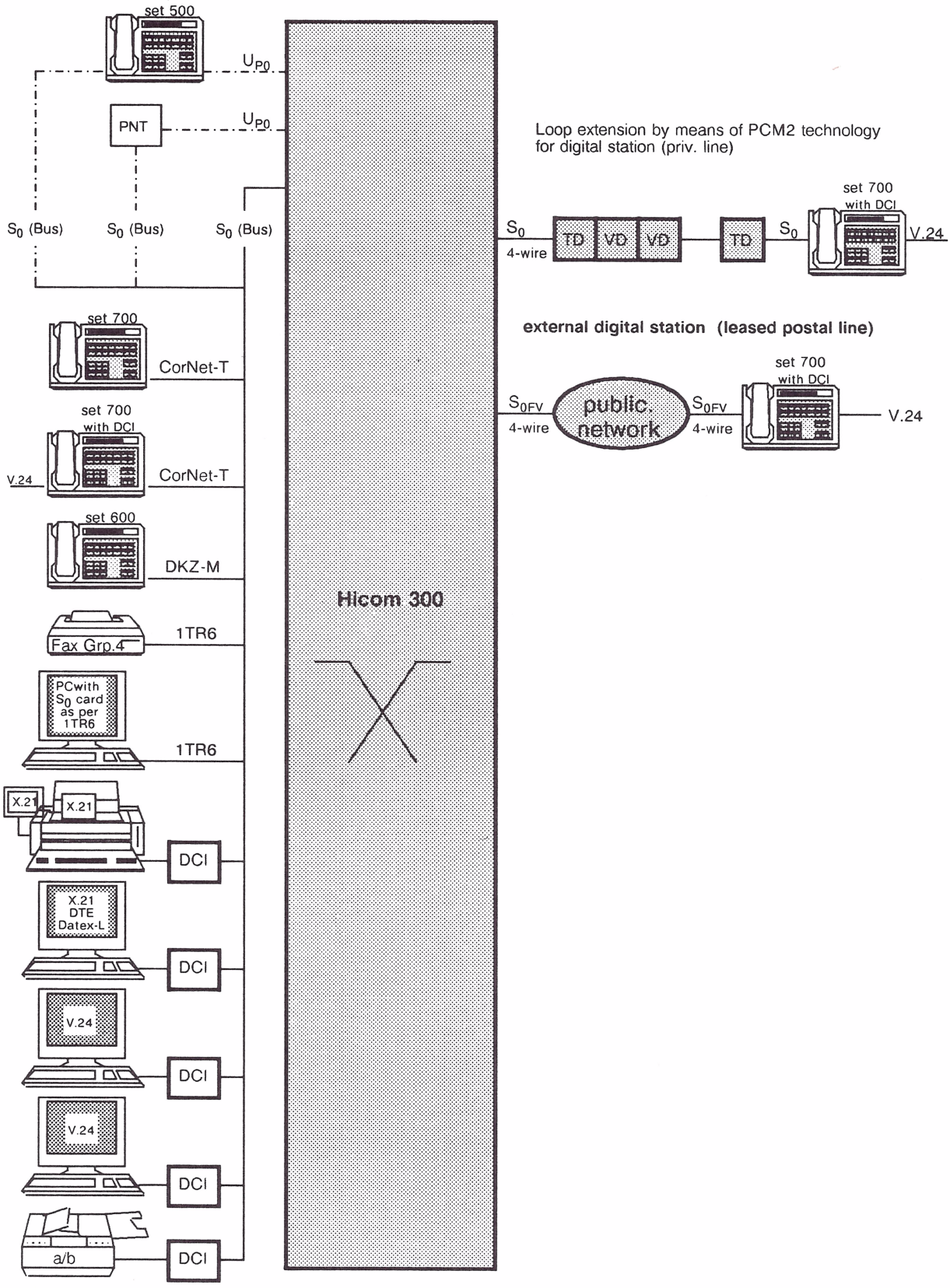


Fig. B1-2: New Hicom 300 user/server interfaces

B2 Basic system for future innovations

The Hicom 300 communication system is a basic system designed for future innovations. The standard interfaces between all units of the system allow the addition or replacement of new system units.

Within these system units either special system interfaces or standard interfaces (multibus, SCSI interface) are used.This permits system innovations on the scale of complete system units, or individual modules.

The same applies to the software. Between each of the software complexes there are message interfaces which are standardized for the whole system. In the case of the switching software, for example, these message interfaces separate the hardware-linked programs for the transport layers (peripheral process) from the equipment-specific and signaling-specific programs (line signal processing) and these, in turn, from the programs which actually control the connections (call processing). The call processing programs also have message interfaces between their service-specific and equipment-specific parts.

This results in an upward and downward modularity, which facilitates the addition of new services, equipment and features to supplement the existing call processing software functions.

The other software complexes have a similar modular configuration, e.g. the administration and maintenance programs and the dependability programs.

B3 Features of the ISDN Communication System Hicom 300

The features of the Hicom 300 ISDN communication system are provided by three function blocks - the switching unit, integrated servers and adapted servers - corresponding to the structural design of the systems.

B3.1 Switching unit

The call processing features enable services for voice, text, image and data to be implemented. The features are divided up according to these services and may differ within the various services depending on the unit involved (e.g. code procedures or key procedures). A distinction is made between the following services:

- telephony,
- facsimile (Fax),
- teletex (Ttx),
- videotex (Vtx),
- data.

In addition to the connection capabilities of the units associated with these services, particular importance must be attached to their functional integration – even if they are distinct units – and to the integration of services within one unit: the Hicom 3510 multiterminal.

B3.1.1 Individual services

The **telephony** service is handled:

- by means of terminal units with an analog interface
  (analog telephone with dial pulsing or DTMF),
- by means of trunk circuits to the public telephone network
  (pulse signaling system IKZ, main station interface HKZ) and to private networks,
- by means of an innovative attendant console with a VDU, and with facilities for utilization of the electronic telephone directory,
- by means of the digital telephone in different variants (Hicom set 211, set 260, set 421, set 451, set 521 and set 721 feature telephones) with graded complements of features and facilities
- by means of the Hicom Multiterminals.

The scope of these features for the telephony service corresponds basically to that of existing analog SPC systems. The feature telephones, which are also integrated in the Hicom MT 3510, MT 3520 Multiterminals, offer enhanced features. The feature telephones and the Hicom Multiterminals have operator prompting; dialog with the user is shown on the display line of the feature telephones, and on the VDU in the case of the Hicom MT 3510, MT 3520 Multiterminals. The feature telephones can also be supplied with chip card readers, which give them additional operating facilities, as with the Hicom MT 3510 Multiterminal:
When the chip card is inserted, the terminal adopts the communication number of the party identified by the card. Users with chip card identification can "transport" their personal data to any Hicom Multiterminal.

With the **facsimile** service, both attended and unattended Group 2/3 or 4 units can be connected.

The **videotex** service can be accessed either directly at the system via an a/b interface or on the S_0 bus by means of an adapter. Both inhouse and public videotex databases can be accessed.

The **data** service can be accessed either directly at the system via an a/b interface using a modem or on the S_0 bus by means of an adapter. This service can also be realized by means of data terminating equipment on the basis of an X.21 or V.24 interface. Adapters with V.24 interfaces can be wired directly at the system or on the S_0 bus, or else they are integrated in the telephone (Hicom set 500/set 700).

B3.1.2 Service integration

There are various forms of service integration, i.e. procedural integration or integration at the user interface:

Integration of discrete devices for the S_0 bus

The S_0 bus offers up to eight terminal ports suitable for a maximum of four voice terminals (different call numbers) and one terminal each for the following non-voice services: fax, vtx, ttx, data.

Terminals capable of handling ISDN are directly connected to the S_0 bus, terminals with conventional interfaces are connected via Hicom adapters DCI .

Fig. B3-1 depicts two examples from a large number of configurations that can be realized for the S_0 bus, :

Essential capabilities:

- Assigning several terminals to a single person and using them for incoming/outgoing traffic with a single telephone number (simultaneous multiple communication),
- Using this configuration for mixed communication, i. e. simultaneously setting up and maintaining two connections to/from the same or another party.

Integration in the Hicom MT 3510 Multiterminal

The Hicom MT 3510 Multiterminal combines the voice, text, image and data communication services. It provides facilities such as display copy and contains both data features and additional message handling functions. With the display copy function texts and data pages are transmitted from one terminal screen to another at 64 kbit/s while a simultaneous telephone connection is maintained on the second available channel.

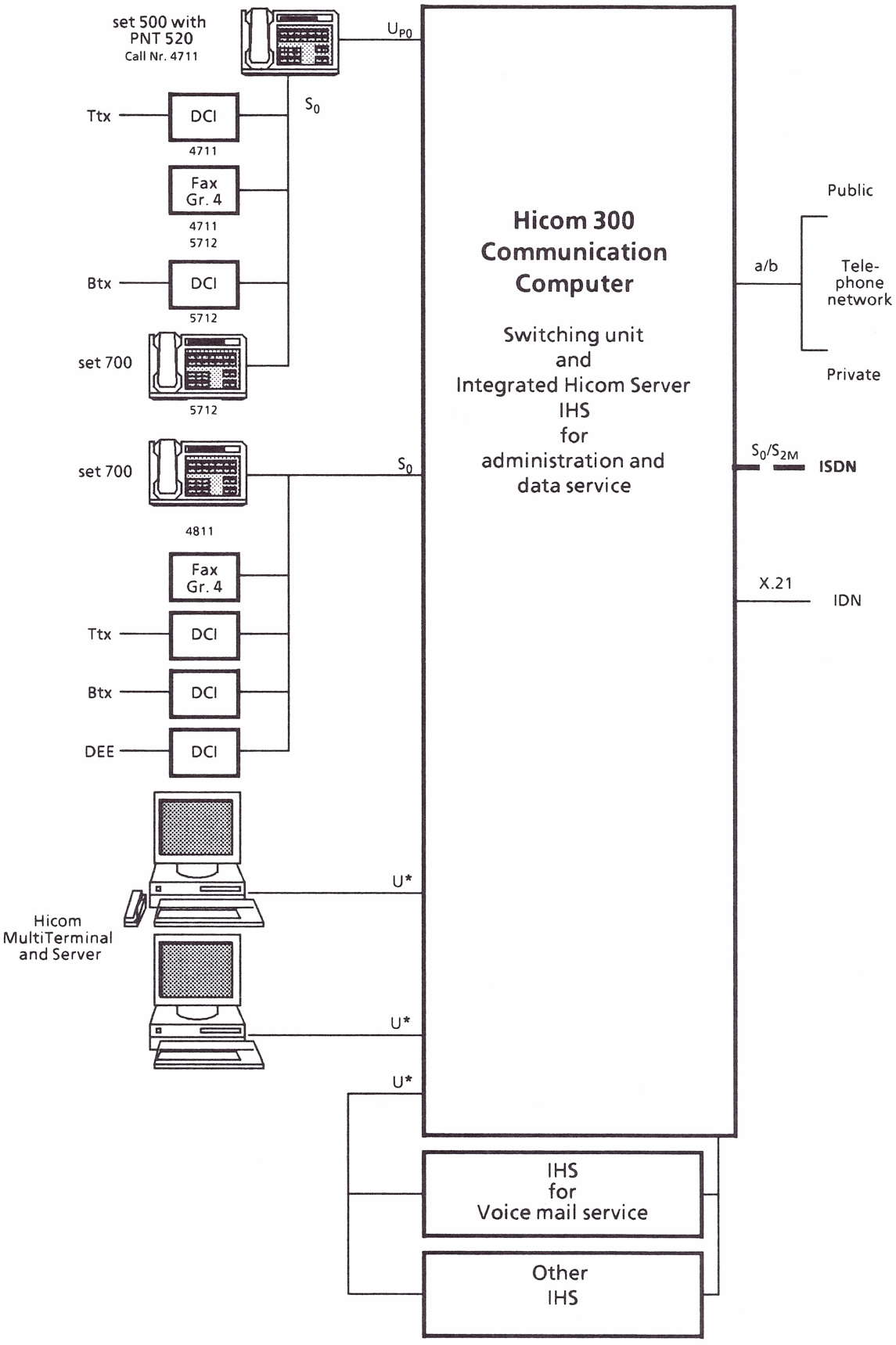


Fig. B3-1: Service integration

B3.2 Features of the integrated Hicom servers

The integrated Hicom servers supplement the features of the switching unit with the addition of communications functions which require the buffering of information; on the other hand, these servers provide information processing functions that are closely linked to the communications functions of the system.

Some of the function complexes of the servers are mandatory, some optional, and they have the following major characteristics:

Administration and maintenance and data applications

- System administration and maintenance functions
  This function complex covers system startup and maintenance. The components and functions are controlled (with masks) by way of a directly connected service terminal and/or optionally via a test and diagnostics center which can be connected to the system by dedicated or dial-up lines. A distinction is drawn between remote administration and remote maintenance:
  - Remote administration (optional)
    The remote administration facility allows the Hicom 300 communication system to be administrated from an external center.
  - Remote maintenance (optional)
    If any irregularities occur in systems which have the remote maintenance facility, information is passed automatically to the Siemens service center via the public network. The results of continuous test routines are transferred regularly, allowing the service center to respond even before a fault becomes noticeable in system operation.
- Data aquisition functions
  The data management system DMS of a Hicom server permits the creation, processing and deletion of data files on different data media (e.g. magnetic disks, cartridges, floppy disks) for data collection purposes, e.g. connection data recording for charge registration or compilation of traffic statistics for monitoring the system load.
- Transport functions
  The communication management system CMS of the Hicom server performs all the functions associated with the transfer of information between the Hicom Communication System and the processing systems (hosts). Different communication protocols are used to transmit both complete data files and individual items of information effectively and safely in dialog applications. The transport functions of the CMS include the segmentation of messages and the multiplexing and checking of data flows.
- Call charge processing functions (optional)
  One of the system's most important data applications is the logical editing of charge data on the basis of various user-specific criteria, with subsequent output on terminals, data media or processing systems.
  User-related charge registration - based on the medium of communication (e.g. voice, text) and the PTT specifications - also forms part of this function complex.
- Controlled connection setup (optional)
  By way of the Hicom switching channel (ACL), a data processing installation (host computer) hooked up to the system can call down and set user features, monitor devices, and set up connections under program control between internal and external terminals on the data channel.
- Telephone data service (optional)
  This Hicom feature enables digital telephone terminals to enter into a direct dialog with applications in a connected data processing system.

- Telephone directory (optional)
  The Electronic Telephone Directory (ETD) data application is an information system specifically designed for attendant personnel and other Hicom users with a suitable terminal; it can contain all Hicom network users and facilitates call setup considerably.
- Network Management Center (optional)
  This permits operation of a network of telecommunications systems in the form of a corporate network. The following functions are incorporated:
  - maintenance functions
  - administration functions
  - database/software administration
  - security functions, recherche functions in connection with alarms
  --network administration
- Analysis of load measurement (optional)
  The load measurement data on hard disk is compressed to form valuable information and is printed out in tabular form or displayed at the service terminal. Multiple evaluation of the measuring data on the basis of different criteria is also feasible. Analysis can be based on measrement days, measurement intervals, measuring points, directions of seizure, and services.

Voice mail service (optional)

This service adds to the voice transmission functions of the switching unit by storing voice messages for specific recipients.

The reasons for this type of information storage include.
- temporary non-availability of the recipient,
- multiple transmission of the same item of information to different recipients,
- delivery required to a certain person at a specific point in time, e.g. to save charges and/or to restrict access to certain information.

The duration of the storage period is largely dependent on the actual application or the user and access to the stored information is primarily organized according to user requirements.

There are two basic types of storage function complexes:

- Store-and-forward functions

  Delivery of a message to a receiving station addressed by the sender constitutes a directed, active delivery in which due consideration can be given to delivery times and priorities.

  This function complex also includes:
  - broadcasting of messages to a number of different recipients,
  - transmission at a preset time,
  - I/O journal, etc.
- Hicom mailbox service

  Unlike the store-and-forward service, the message is not actively delivered; instead, it is deposited in a user/person-related voice mailbox (infobox) in the server for subsequent retrieval.

  Access to the message by the recipient is allowed after a password check and is possible from almost any place or at any time. The infobox functions include a visual and/or audible indication (depending on the terminal unit) for the user that messages have been deposited in his mailbox, with information as to the sender and the time and date of reception.

Tele Communications Service (optional)

This group of services expands the call processing functions of the Hicom switching unit through the addition of storage functions for text and facsimile messages.

The functions offered are roughly the same as those associated with a voice mail service.

Access to text mailboxes is possible by way of PCs and original teletex devices; access to fax mailboxes is likewise ensured by way of PCs and combinations of devices (telephones/fax machines). There are additional facilities for automatic conversion/adaptation between fax group 2 and 3 messages and interworking of text messages in T61 format in fax messages and also for precise tracing of all messages which have passed through the storage.

B3.3 Features of the adapted servers

The Hicom MT 3510 Multiterminal is used for voice, text, image and data communication. It provides its features in conjunction with the Hicom 300 ISDN communication system. Its functions are divided between the MT 3510 terminal and the *adapted* server S 3510. One server processes the instructions of several multifunctional terminals simultaneously.

S 3510, Server for the Hicom MT 3510 Multiterminal

- Text communication service
  This service incorporates the functions of filing, electronic mail and central printing. The filing facility comprises the storage of text messages in a personal file location in the server. Text messages are exchanged via the mailbox for electronic mail, and the arrival of a message is signaled at the multiterminal of the receiving user. All Hicom MT 3510 Multiterminals allow access to a central print facility for the provision of hard copy, and a local printer can also be connected up to the server.
- Data communication service
  The data communication service enables the user of the Hicom MT 3510 Multiterminal to access data processing systems. The Hicom MT 3510 Multiterminal then behaves like a data display terminal. Two types of data communication which operate on separate servers are offered:
  - Emulation 9750 for dialog with Siemens data processing systems,
  - Emulation 3270/SNA for dialog with IBM data processing systems.
- Loading service
  The entire loadable software for the Hicom MT 3510 Multiterminal is loaded via the S 3510 server. Personal data, such as a telephone directory, can be saved in the server and loaded again from there into the terminal.
- Administration
  This service is offered to the user of the Hicom MT 3510 Multiterminal via the basic server system; amongst other things it can be used to alter the password.

Additional servers

The videotex server is a further adapted server. It performs the control and storage operations necessary for handling the videotex functions. The Vtx server means that all the functions of the videotex service already introduced into the public telephone network will be possible in the PBX sector; moreover special emphasis is placed on having the same operator inputs. The universal server will have a special control unit which ensures optimum connection to the Hicom 300 system.

Vtx is accessible by means of Vtx terminals or the Hicom MT 3510 Multiterminal. When the Hicom MT 3510 Multiterminal is used, mixed-mode communication will provide a substantial enhancement to the videotex service.

The standard interface design of the Hicom 300 ISDN communication system will allow future requirements to be met by the implementation of additional servers for corresponding functions.

ISDN Communication System Hicom 300

1 System architecture

The digital ISDN communication system Hicom 300 with software-control throughout has the same structures for hardware and software at all capacity stages; it is therefore ensured that the systems have the same user interface for the service personnel.

The system can basically be divided into two functional blocks:"switching" and "store-and-forward" functions.

The **switching unit SWU** takes over the tasks of "switching". For Hicom 300 with ≤960 ports it consists of the periphery, the switching network SN and the common control CC. The switching unit of the Hicom 300 system with ≤5120 ports comprises several of these switching units connected via "Central Devices" to a "Common Control CC"

Higher-level services in the form of store-and-forward-functions are processed by the **servers,** which are assigned to the switching unit. The Administration and Data Service ADS on the IHS is an integral part of the communication computer due to its central tasks (loading and saving). All integrated and adapted servers are the same for all capacity stages of the Hicom 300 system.

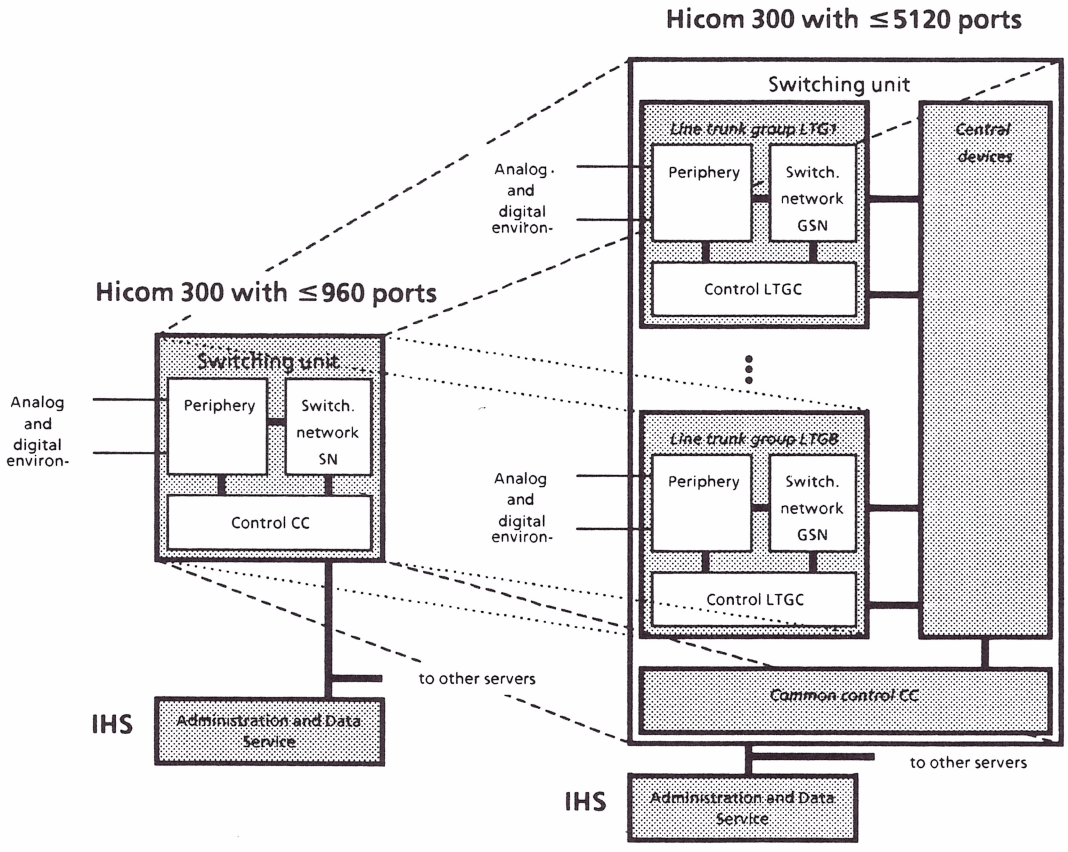


Fig. 1-1: Basic structure of the Hicom 300 system

Modern communication systems must meet particularly high availability requirements. The Hicom 300 ISDN communication system meets these requirements with the administration and maintenance and the dependability functions available at all capacity stages. In addition, for the higher capacity stages of the Hicom 300 system, the most important functional units may be duplicated.

1.1 Switching unit SWU Hicom 300 with ≤960 ports

The switching unit of the Hicom 300 system with ≤960 ports consists of the following functional units:

- Periphery
  - Line Trunk Unit LTU
    - * Hicom 300 with ≤256 ports max. 2 LTUs
    - * Hicom 300 with ≤960 ports max. 6 LTUs
  - Service Unit SU
- Switching Network SN
- Common Control CC
  - Data Communication Link DCL
  - Peripheral Clock Generator PCG
  - Data Processor DP
  - Memory MEM
  - Interface Processor IP

1.1.1 Periphery

The periphery of the Hicom 300 system comprises the line trunk units LTU and the service unit SU.

Line trunk unit LTU

Station and trunk-related circuit modules form the interface between the communications system and the analog or digital environment. They are combined both functionally and constructively to form the line trunk unit LTU, which has various capacity stages.

The line trunk unit LTU provides compatible mounting spaces for 20 line circuit modules and an interface module to the switching network SN and to the common control CC, the line trunk unit control LTUC.

There are up to 160 ports for external connections. The line circuit modules in an LTU are connected via the LTUC to the switching network by way of 4 voice/data channels each with 32 time slots with 64 Kbit/s. This gives a data rate of 2048 Kbit/s. Messages are exchanged with the control by way of a signaling channel (2 Mbit/s) on an HDLC point-to-multipoint basis.

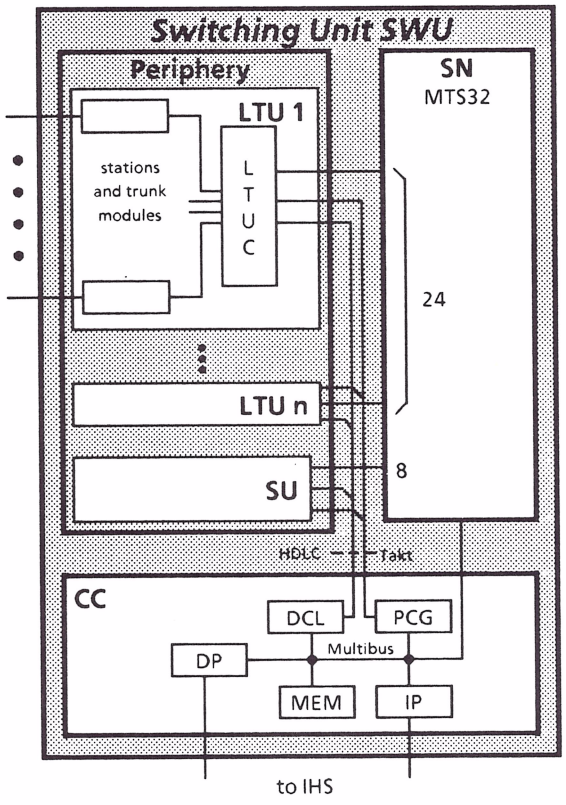


Fig. 1-2:
Functional units of the SWU
Hicom 300 with ≤960 ports

Service unit SU

The service unit SU consists of the signaling unit SIU and conference unit CONF.
The signaling unit SIU supplies the signals required by the system (generation of audible tones, music on hold, announcements) and receives the pushbutton signals and central office dial tones. In addition to conference calls (e.g. add-on conferences), the conference unit CONF offers the functions "≤call waiting" and "override".
Both the SIU and CONF are accommodated in the control unit, but the software treats them as LTU modules; they are connected to the switching network via 4 voice/data channels each.
The ring generator generates either 25 Hz or 50 Hz for the analog telephone sets or for ac signaling in tie trunk traffic; functionally it forms part of the service unit SU, but constructively it is located in the LTU.

1.1.2 Switching network SN

The basic module for the digital switching network of the Hicom 300 system is a single-stage, non-blocking time switch MTS 16. Interconnection of two modules (MTS 16) gives a switching stage for 1024 time slots (32 multiplex channels of 32 channels each). Of the 32 incoming and outgoing multiplex channels for voice or data, this time switch MTS 32 connects any 2 of 32 time slots.

Besides single-channel connections with a bit rate of 64 kbit/s, broadband connections with n×64 kbit/s are also possible. In addition to this, broadcast connections can also be maintained (one signal source to several signal receivers).

Each MTS can be broken down into the following functional units: sequence controller, time switch, multiplexer, line receiver and line driver.

Setting of the switching network is performed by the data processor via the multibus.

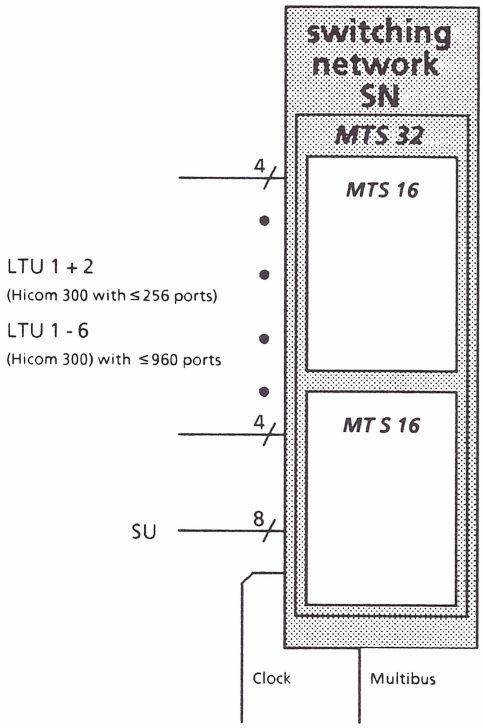


Fig. 1-3:
Functional units of the switching network SN/Hicom 300 with ≤960 ports

1.1.3 Common control CC Hicom 300 with ≤960 ports

The heart of the switching control is the data processor (DP), which is connected to the associated memory modules (MEM) by way of a multibus. Connection to the servers is established by the interface processor (IP); this converts the control's internal multibus to the IEC bus, which is suitable for greater distances.

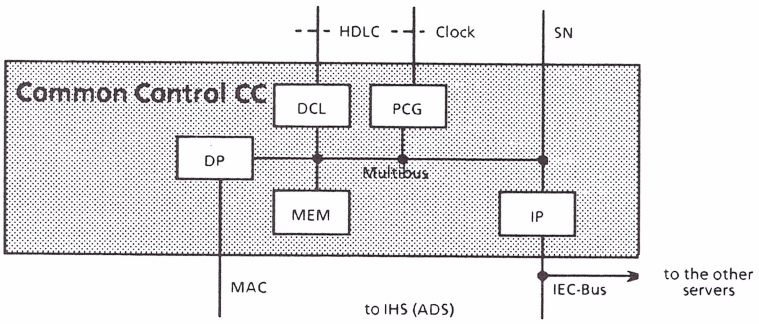


Fig. 1-4: Functional units of the common control CC

The switching network is set directly by the data processor via the multibus.
The interface to the LTU is the data communication link DCL, which, as the master of the HDLC point-to-multipoint connection, executes the protocol handling on the signaling channel.
The centralized program/data memory capacity is 14Mbyte.
The system's peripheral clock generator PCG permits master-slave synchronization of the central clock pulse which it generates with an external reference frequency (e.g. public IDN or ISDN). The phase locked loop for the oscillator takes the form of a microprocessor-controlled phase frequency locked loop.
In a purely analog environment the clock pulse generator functions as an independent control oscillator.

1.2 Switching unit SWU Hicom 300 with ≤5120 ports

The switching unit of the Hicom 300 system with ≤5120 ports consists of the following functional units:

- Line trunk groups LTG comprising
  - Periphery
    - * Line trunk unit LTU
    - * Service unit SU
  - Group switching network GSN
  - Line trunk group control LTGC
- Central devices comprising
  - Central switching network CSN
  - Central clock generator CCG
  - Central Input Output Control IOCC
  - Message Distributor MD
- Central Control CC comprising
  - Data processor DP
  - Memory MEM
  - Interface processor IP
  - Message buffer unit MBU

1.2.1 Line trunk group LTG

A line trunk group LTG in the Hicom 300 switching unit with ≤5120 ports has basically the same structure as the Hicom 300 switching unit with ≤960 ports. Differences in the functional units are explained in the following text.

Periphery
The periphery of Hicom 300 with ≤5120 ports is functionally similar to the periphery of Hicom 300 with ≤960 ports. Instead of six line trunk units LTU, however, the periphery of Hicom 300 with ≤5120 ports comprises only four LTUs, so that there are 4×160 ports for external connections. There are four multiplex channels per LTU to the group switching network GSN.

Group switching network GSN
The GSN is equivalent to the switching network of the system Hicom 300 with ≤960 ports. This means that a line trunk group can comprise only four LTUs, as eight multiplex channels of the GSN serve for the connection with the

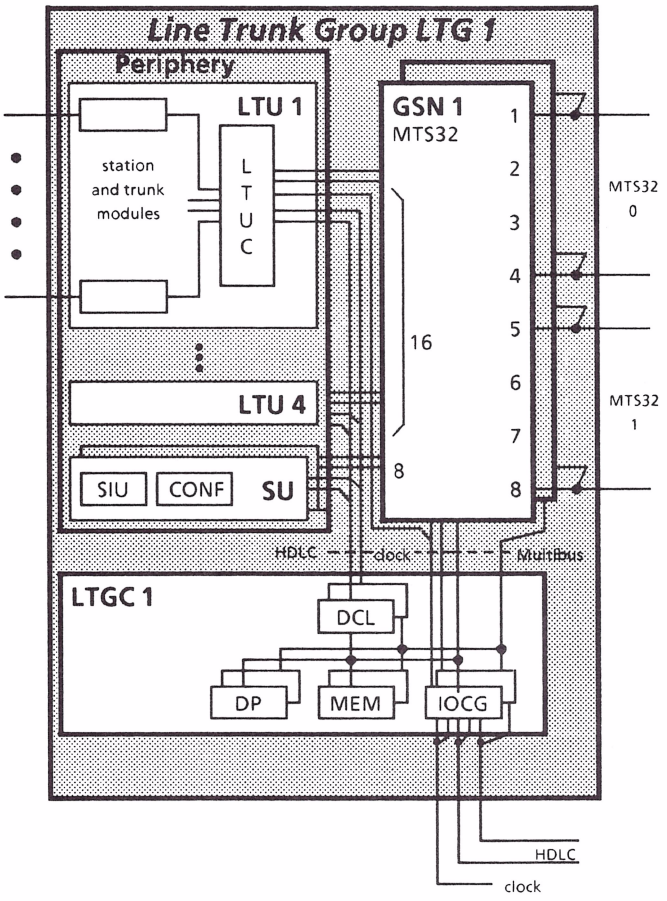


Fig. 1-5:
Functional units of the line trunk group LTG

Line trunk group control LTGC

The line trunk group control LTGC is similar to the control CC for Hicom 300 with ≤960 ports. Loading and securing of system data and clock generation is carried out in the common control and the central devices, so there is no need for the interface processor IP or the peripheral clock generator PCG in the LTGC. The LTG input/output control group IOCG serves as the interface to the central devices or the common control CC. It contains the actual input/output control and the clock repeater CR. The input/output control is used for the transmission of messages and start-up data between the LTGC and the common control CC. The clock repeater CR provides the periphery and the group switching network with the system clock pulse.

1.2.2 Central devices

The following functional units are central devices:

- Central switching network CSN,
- Central clock generator CCG,
- Central input/output control IOCC,
- Message distributor MD.

Central switching network CSN

The central switching network is a time switch for switching 64 kbit/s/channels. It consists of two MTS 32, which makes 64 voice multiplex lines available for call processing. Each line trunk group LTG is connected to the CSN via eight voice multiplex lines; in the CSN they are divided into 2x4 voice multiplex lines and connected to the two MTS 32.

Setting of the CSN is performed by the common control CC. To enable protected data transfer over great distances, data is transferred between the common control and the central devices according to the HDLC procedure. The central input/output control IOCC is the interface that converts the HDLC transmission method to multibus operation.

Central clock generator CCG

The central clock generator CCG is driven by the common control CC via the central input/output control and generates the central system clock pulse like the PCG. This system clock pulse is connected to the clock repeaters CR. The central clock generator can synchronize itself, just as the peripheral clock generator can, to an external (public network) reference clock in the case of a digital environment. Each line trunk group LTG accommodates a clock repeater in the input output control group IOCG; this clock repeater passes the system clock pulse generated by the central clock generator CCG to the corresponding functional units. The system clock pulse required by the central switching network is supplied by the CR accommodated in the central input/output control.

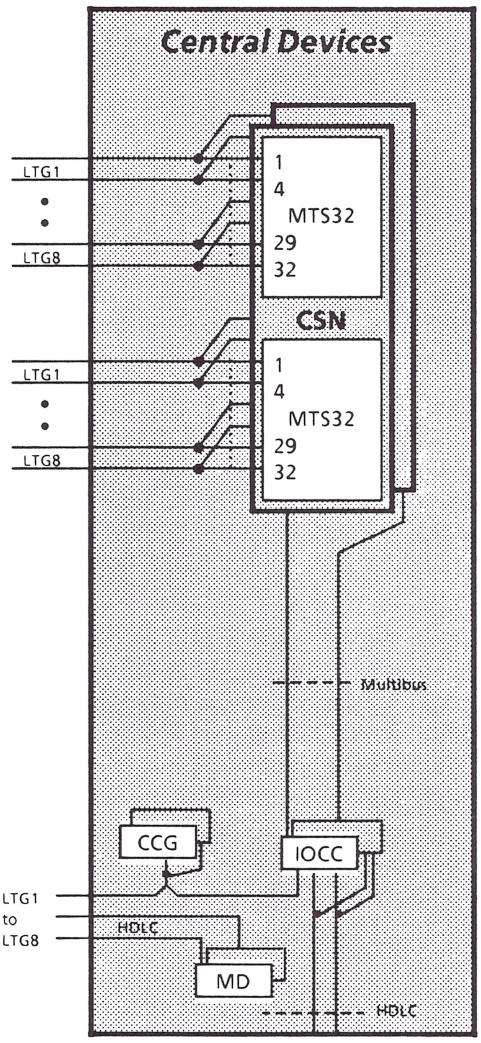


Fig. 1-6:
Functional units of the central devices

Central input output control IOCC

The central input output control IOCC comprises the input/output control, the clock repeater and the switching logic for external reference clock.

The tasks of the input/output control are processing the messages to the common control, controlling the central switching network and controlling the central clock generator.

Message distributor MD

The message distributor MD has the task of multiplexing or demultiplexing the data lines (HDLC links between the common control and the line trunk groups LTG 1 to LTG 8).

1.2.3 Common control CC

The common control comprises the following functional units:

- Data processor DP,
- Memory modules MEM,
- Interface processor IP,
- Message buffer unit MBU.

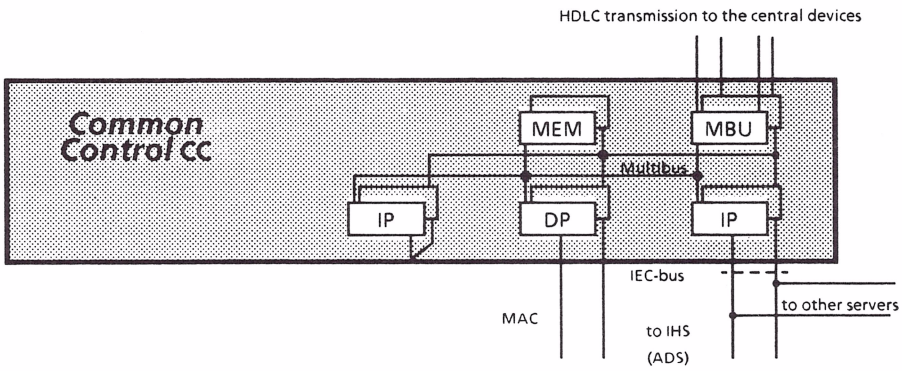


Fig. 1-7: Functional units of common control CC

The heart of the switching control is the data processor DP, as is the case with Hicom 300 with ≤960 ports; the DP is connected to the appropriate memory modules MEM via a multibus.

As the multibus is only suitable for short data transfer links (within a shelf) for electrical reasons, the following transmisssion methods are used for greater distances:

- HDLC method and
- IEC bus method

The central switching network is set via a HDLC point-to-multipoint-connection; the interface for this and to the line trunk groups LTG is the message buffer unit MBU in the common control CC.

Data is exchanged between the administration and data server ADS and the Common Control CC by way of the IEC bus. The active interface processor IP has the task of converting data from the multibus to the IEC bus and vice versa.

The two other IPs in the CC have the task of exchanging data between the active common control unit and the stand-by common control unit so that it is ensured that the memory contents of both common control units are identical.

The centralized program/data memory capacity is 14 Mbytes.

1.3 Integrated Hicom servers (IHS)

The various integrated Hicom servers - consisting of up to three modules of the same type - have a standard basic structure, comprising:

- server common control SM-CC,
- peripheral memory,
- line periphery.

The server common control SM-CC essentially consists of the same entities (data processor, main memory, interface processor) as the control of the switching unit (SWU). Peripheral bulk storage facilities, such as hard disks and floppy disks, are served by an I/O processor IOPS via the standard ANSI interface SCSI (max. 4 storage units). The line periphery of the servers is accessed by way of a bus interface for up to 7 line modules.

The servers are connected to the SWU via the IEC bus. Connection to an LTU is established by way of the U* interface.

The special demands placed on the individual servers result in a specific line periphery and different peripheral memory configurations.

1.3.1 IHS for administration and data service ADS

The functions of the administration and data service are as follows: loading and saving the system data files and adaptation of the service terminal BT. These centralized functions make the ADS an integral part of the communication computer.

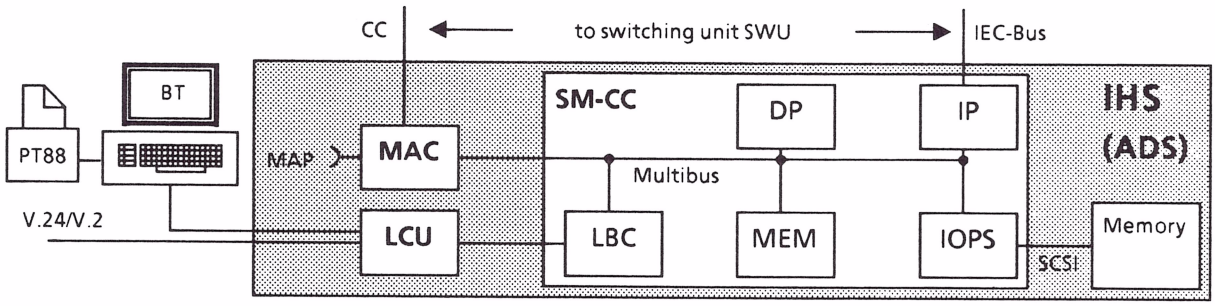


Fig. 1-8: Functional units for the administration and data service ADS

The peripheral memory of this IHS comprises:

- a floppy disk drive for the input of system programs and for the input and output of system and user files, and
- a hard disk unit for the storage of all program complexes and system and user files used in the system.

The line periphery of the ADS consists of a maximum of three line controllers LCU each with two V.24/V.28 interfaces for the operation of synchronous and/or asynchronous data lines at a speed of ≤9600 bit/s.

The maintenance and alarm control module MAC edits all information to and from the maintenance and alarm panel MAP; it also provides the system with a highly accurate reference clock with battery backup.

The service terminal BT comprises a monitor, a keyboard unit and a printer.

1.3.2 IHS for voice mail service VMS

The voice mail service VMS is used to buffer spoken messages (store-and-forward service, mailbox service).

Analog and digital pushbutton standard telephones are used to operate the IHS. If standard telephones with rotary dial are used, a compact frequency transmitter ("Infotip") is required for entering the commands.

The peripheral memory of the VMS consists of two hard disk units for the buffering of messages to be forwarded, for storage of the address and group code files, the I/O journal and the saving of outcall requests to the various recipients. The second hard disk unit is used not only for expansion of the message storage capacity but also for redundant storage of important message administration data, in order to prevent messages being lost if one of the hard disk units fails.

If the number of users to be served by the voice mail service exceeds the capacity of an IHS, up to three modules of the same type can be operated in such a way that their behavior toward the user is the same as that of an appropriately expanded IHS.

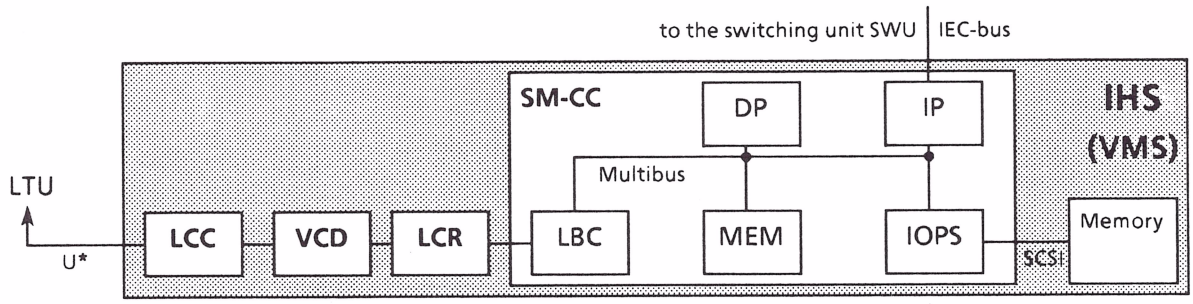


Fig 1-9: Functional units for the voice mail service VMS

The line periphery can be subdivided into the line controllers LCC and LCR for the handling of the bit streams in the two B channels, and for series/parallel conversion and interfacing in the D channel.

The digital voice compression module VCD is used for compressing/decompressing the voice information, for eliminating and generating voice pauses and for detecting control signals and transmitting audible tones.

1.3.3 IHS for Tele Communications Service (TCS)

The TCS provides the functions of buffering, distribution and conversion for text and facsimile messages.

The peripheral memory of the TCS consists of two hard disk units, like the peripheral memory of the VMS.

If the number of stations to be served in the text and facsimile service exceeds the capacity of an IHS for TCS, up to three modules of the same type can be connected in parallel, as is the case with the VMS.

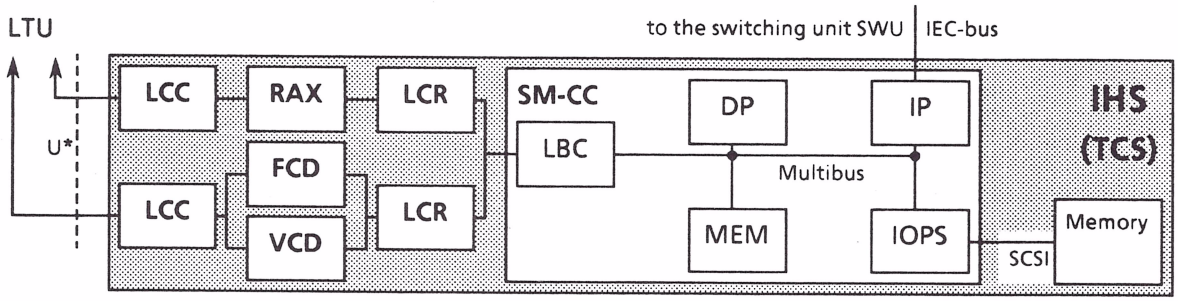


Fig. 1-10: Functional units for the Tele Communications Service

With the line periphery of the IHS for TCS, a distinction is made between the facsimile line periphery and the Ttx line periphery.

The facsimile line periphery, comprising the two line controllers LCC and LCR, the digital facsimile control FCD and the VCD module, performs the conversion of the data arriving via the U*-interfaces and going to the multibus of the server common control and vice versa.

The FCD performs the following functions:

- Reception of the analog-modulated (amplitude or phase) and PCM-coded 64-kbit data stream and filtering of defined frequencies (signaling phase between facsimile device and FCD).
- Generation of the analog-modulated data and its transmission in PCM-code as well as generation of defined frequencies (signaling phase).

If analog terminal equipment is connected, the VCD is used for voice output in the case of operator prompting and user input by DTMF signals.

The Ttx line periphery consists of the line controllers LCC, LCR and the baud rate adapter RAX, which is used for the following functions:

- Generation of the envelope structure (minimum requirement X.21 protocol) in the 64-kbit/s data stream to the line circuit control LCC.
- Division of the 64-kbit/s data stream of the LCC into the corresponding speed format to the LCR with filtering out of the I-information (Indication, minimum requirement of X.21 protocol).

1.4 Adapted servers

1.4.1 S 3510, Server for the Hicom MT 3510 Multiterminal

The basic hardware of the S 3510 server comprises

- the system unit consisting of
  - processor, memory, management unit,
  - main memory,
  - floppy disk drive,
  - disk controller,
  - hard disk drive,
  - one to three U* interfaces,
  - connection unit for monitor, keyboard, printer,
- the keyboard and
- the monitor.

The software of the S 3510 server can be divided into three function blocks:

- user services,
- basic system of the server and
- U* interface software.

The user features cover text communication, word processing, data communication and two administrative functions: the loading service and password service. These features can be called up via the Hicom MT 3510 Multiterminal.
The basic server system contains the functions that are common to all services, such as the communication equipment.
The interfacing procedures from and to the Hicom 300 communications system are handled via the U* interface software.

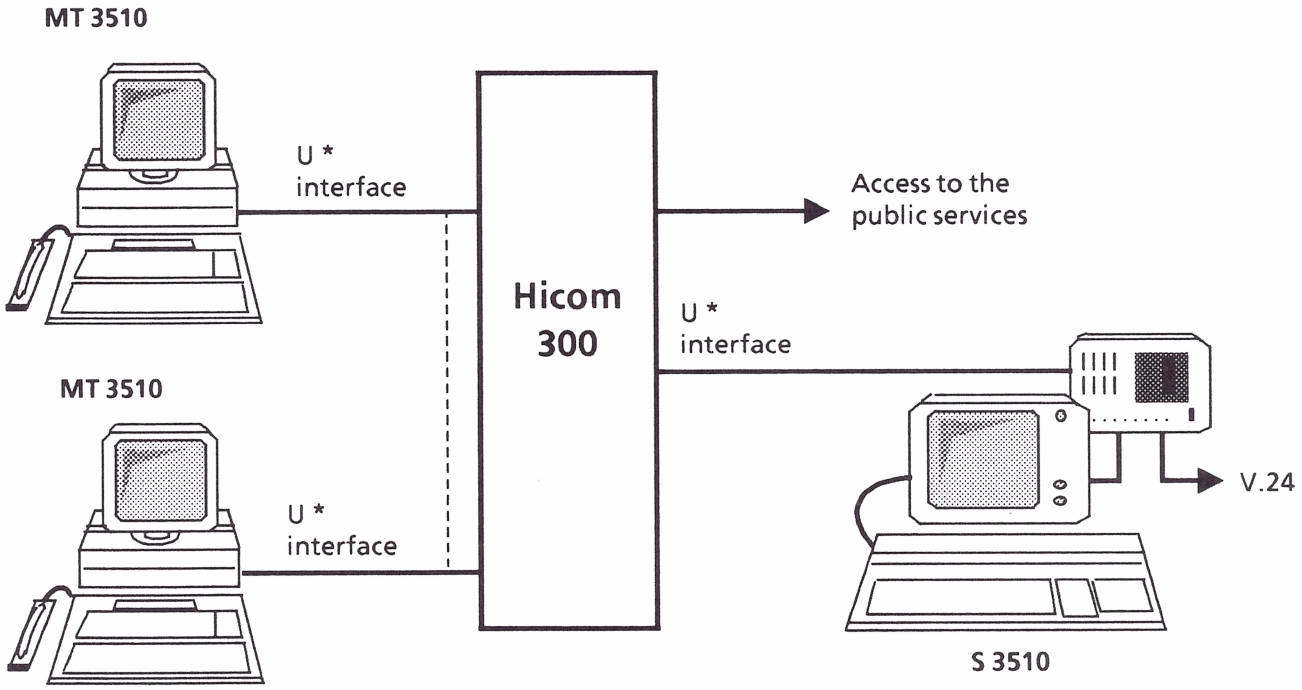


Fig. 1-11: Connection of the Hicom 3510 Multiterminal

1.4.2 Other adapted servers

Further adapted servers can be implemented for future expansion at minimal expense on the basis of the standard interface structure of the Hicom 300 ISDN communication system.

1.5 Hicom adapters and nework terminations

Hicom adapters are used to connect terminal equipment not conforming to the ISDN interface standard. These adapters are designed to convert the powerful, future-proof digital single-channel and two-channel interfaces of the Hicom 300 system to the conventional interfaces of data processors, data terminals, personal computers, facsimile servers group 2 and 3, vtx terminals, teletex terminals etc.

Network terminations afford the advantages of S_0 bus operation also at locations remote from the Hicom 300 system. They enable physical conversion from U_{P0} to S_0 and hence a flexible network topology to be realized; i.e. terminal equipment may, for instance, be installed at a distance of up to 2.5 km from the Hicom 300 system.

Users of a Hicom two-channel telephone (Hicom set 551 or Hicom set 751) can be provided with telephoneplug-in cards performing adapter or network terminating functions.

Hicom adapters
The adapters used for Hicom 300 are subdivided into:
- Adapters (separate units) for the S_0 interfaces (two-channel interface - see Fig. 1-12/②);
- Adapters (separate units) for the U_{200} interfaces (single-channel interface - see Fig. 1-12/④);
- Integrated adapters (see Fig. 1-12/③).

Network terminations (see Fig. 1-12/①)
The following S_0 network terminations are used for Hicom 300:
- PNT (Private Network Termination) with supply to S_0 terminals and
- PNT 520 (pluggable in Hicom set 551) without supply to S_0 terminals.

1.5.1 Hicom adapters

All Hicom adapters comprising a V.24 interface are capable of communicating with each other, provided they use the same bit rate adaption procedure (e. g. DMI mode 2). Adapters for telematic terminals can communicate only within their service.

Hicom adapters for the S_0 interface (two-channel interface)

For operation with the two-channel S_0 interface, the adapter ranges DCI 700, DCI 600 and the UTC adapters are provided.

- DCI 731 with V.24/V.28 interface, with the future CorNet-T protocol, permits all existing Hicom features to be utilized for data communication; connection for point-to-point and bus operatin being provided. Aside from the commonly used bit rate adaption procedure DMI mode 2 asynchronous, DCI 731 also implements bit rate adaptations as per CCITT I.463 (V.110, ECMA 102) and X.30.
- The DCI-600 range connects terminals with main-station capability (one terminal for each service) to Hicom via the S_0-station line, utilizing the Hicom concentrator function. This is based on the public protocol 1TR6 of the Deutsche Bundespost Telekom.
  - DCI 639
    for connection of Ttx terminals,
    Bit rate adaption by flag stuffing,
  - DCI 638
    for connection of Datex-L terminals with X.21 interface or conventional V interfaces,
    Bit rate adaption as per X.30,
  - DCI 637
    for facsimile server groups. 2/3 and vtx servers with a/b interface,
  - DCI 631,
    for connection of data terminals and PCs with V.24/V.28 interface,
    Data saving procedure in B-channel,
    Bit rate adaption procedure DMI mode 2 asynchronous, as well as ECMA 102, V.110 and X.30,

- UTC
  for connection of T/AT -compatible PCs with V.24 interface and Teletex software for Teletex/Telex operation.

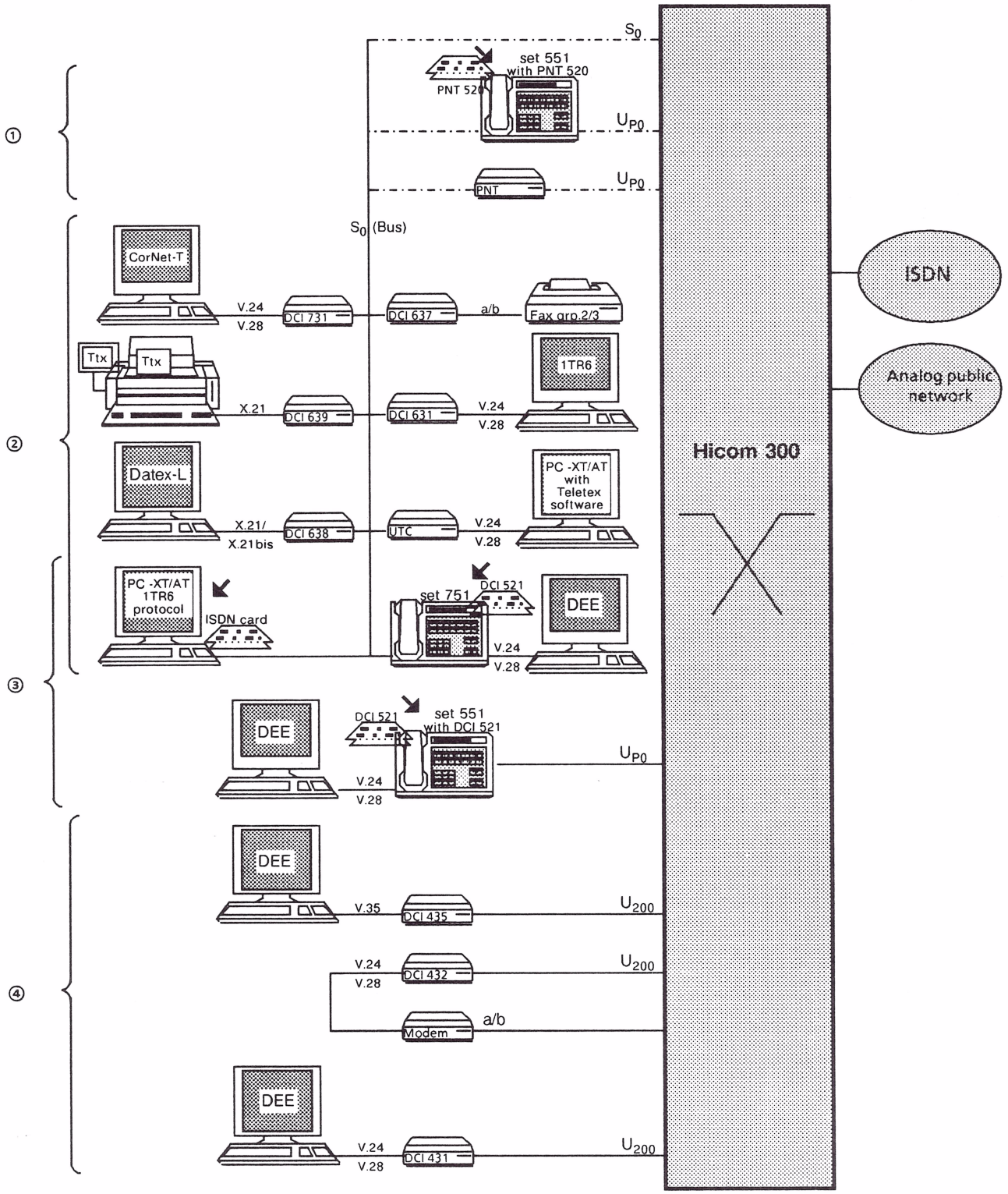


Fig. 1-12: Hicom adapters and network terminations

Hicom adapters for U_{200} interface (single-channel interface)

Adapter range DCI 400 is provided for operation at the single-channel U_{200} interface:

- DCI 431
  for connection of data terminals with V.24/V.28 interface
- DCI 432
  for implementation of a modem pool on the basis of V.24/V.28
  for DCI connections to analog internal and external data ports.
- DCI 435
  for connection of data terminals with V.35 inerfaces for bus link
  for synchronous transmission at high speeds.

All DCI-400 adapters offer the commonly used bit rate adaption DMI modes 0, 1, 2 and 2L for different synchronizing procedures and speeds.

Integrated Hicom adapters

Hicom uses the following integrated adapters:

- DCI 521 (pluggable in Hicom set 551 and Hicom set 751)
  for connection of an asynchronous data terminal with V.24/V.28 interface,
  Bit rate adaption procedure DMI mode 2 asynchronous.
- ISDN card (pluggable in XT/AT compatible PCs)
  for connection of XT/AT compatible PCs with V.24 interface to the S_0 bus.

1.5.2 Network terminations

Hicom 300 uses the following network terminations for connection of S_0 terminal equipment:

- PNT (seperate unit)
  for connection of terminals with S_0 interface,
  U_{P0} interfaces to Hicom 300 system,
  Remote feed of all connected terminals and
  performance of operating functions, e.g. loops.
  PNT is neutral to protocols.
- PNT 520 (pluggable in Hicom set 551)
  for connection of terminals with S_0 interface and separate power supply ,
  Hicom set 551 also supports protocol 1TR6 in addition to the CorNet-T protocol for the terminals wired on the S_0 bus .

Simultanous operation on the S_0 bus

One S_0 bus of the Hicom 300 system can be used to operate up to eight terminals using CorNet-T, DKZ-E, and 1TR6 protocols in mixed fashion (the S_0 bus being connected directly to subscriber line module SLMS, or PNT, or Hicom set 551 with PNT 520).

- Using the TR6 protocol, one terminal per service can be employed
- Using the CorNet-T protocol, up to four terminals each can be employed for the "voice" and "data" services

1.6 Remote switch RMS

The Hicom 300 system enables user stations, station groups, remote systems and lines to be directly operated by means of a remote switch (RMS). The RMS permits the full range of Hicom 300 features to be utilized.

The RMS is a system-controlled distant station without autonomous switching functions. It consists of line circuit modules external to the Hicom 300 system, connecting terminals and lines, up to three interface modules, clock generator, ring generator (if needed), power supply unit and a main distribution frame.

The RMS is accommadated in a basic cabinet CAB 180C (compact design). The cabinet can accommodate a maximum of three line trunk unit shelves (LTUS) with up to 10 line circuit modules each. Trunk circuits and connecting circuits can be configured in addition to the modules for analog terminals, digital terminals and special private features. In doing so, the high traffic values of these circuits should be taken into consideration.
The main distribution frame is accommodated in a distribution box for wall mounting.
Depending on their size, Hicom 300 systems can connect one or more RMS conforming to the above configuration principle.

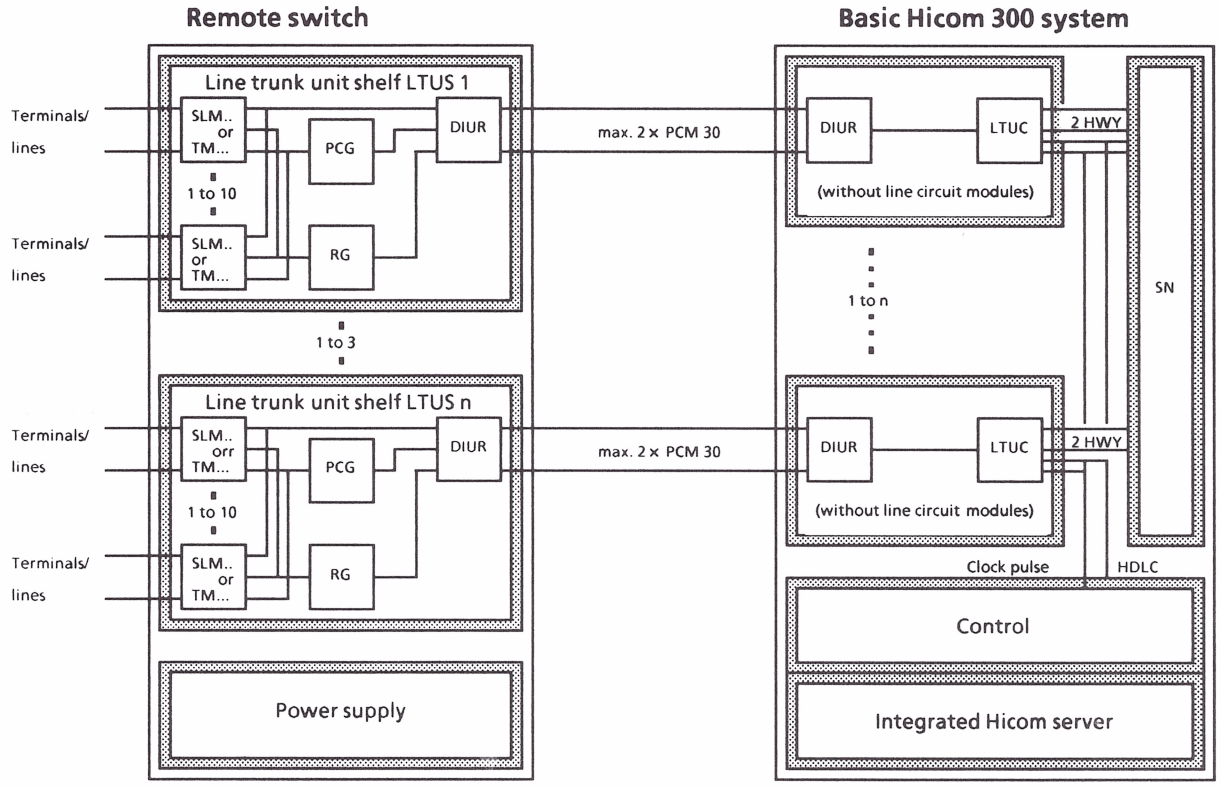


Fig. 1-13: Remote switch RMS

Hicom 300 and RMS are interconnected via a PCM-30 transmission link. This link handles the entire traffic originating from the terminals/lines of the RMS as well as the traffic flowing from the main system to the RMS. The exchange of (signaling and synchronizing) criteria required for this communication is also handled by the PCM-30 link.

The interface between basic system and remote switch is the DIUR module (Digital Interface Unit Remote Switch). For each LTUS one such module is provided in the RMS and in the basic system. In accordance with the expected traffic load (which depends on the number of line circuit modules assigned to the RMS) one DIUR can handle one or two PCM-30 links.

Depending on the cabling, the RMS can be installed at a distance of up to 1300 m from the basic system. When using PCM line equipment of the Deutsche Bundespost (DBP), the maximum line length depends on the permissible delays.

The RMS is fully integrated in the basic system as regards operation and dependability. Example: the RMS is actually configured from the basic system. Dependability system messages are regularly exchanged with the basic system.

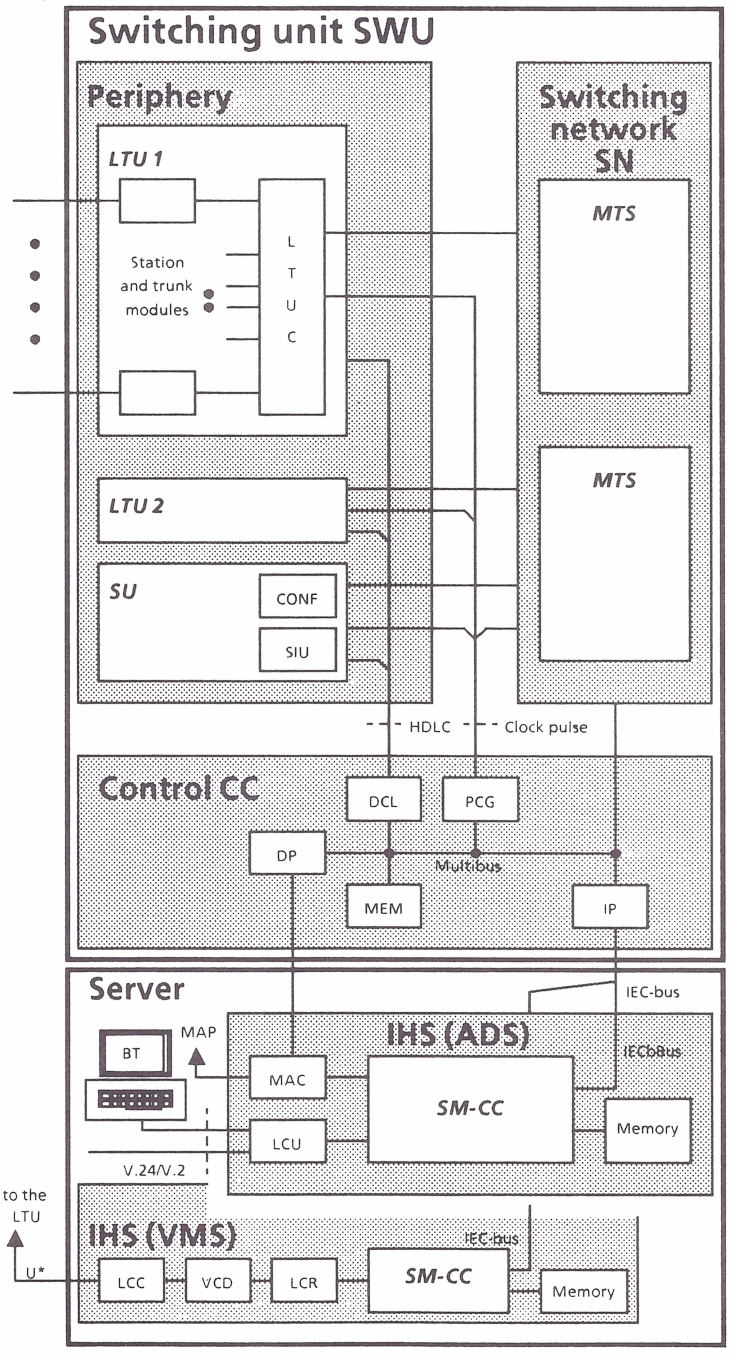


Fig. 1-14: Block diag. of Hicom 300 ≤256 ports

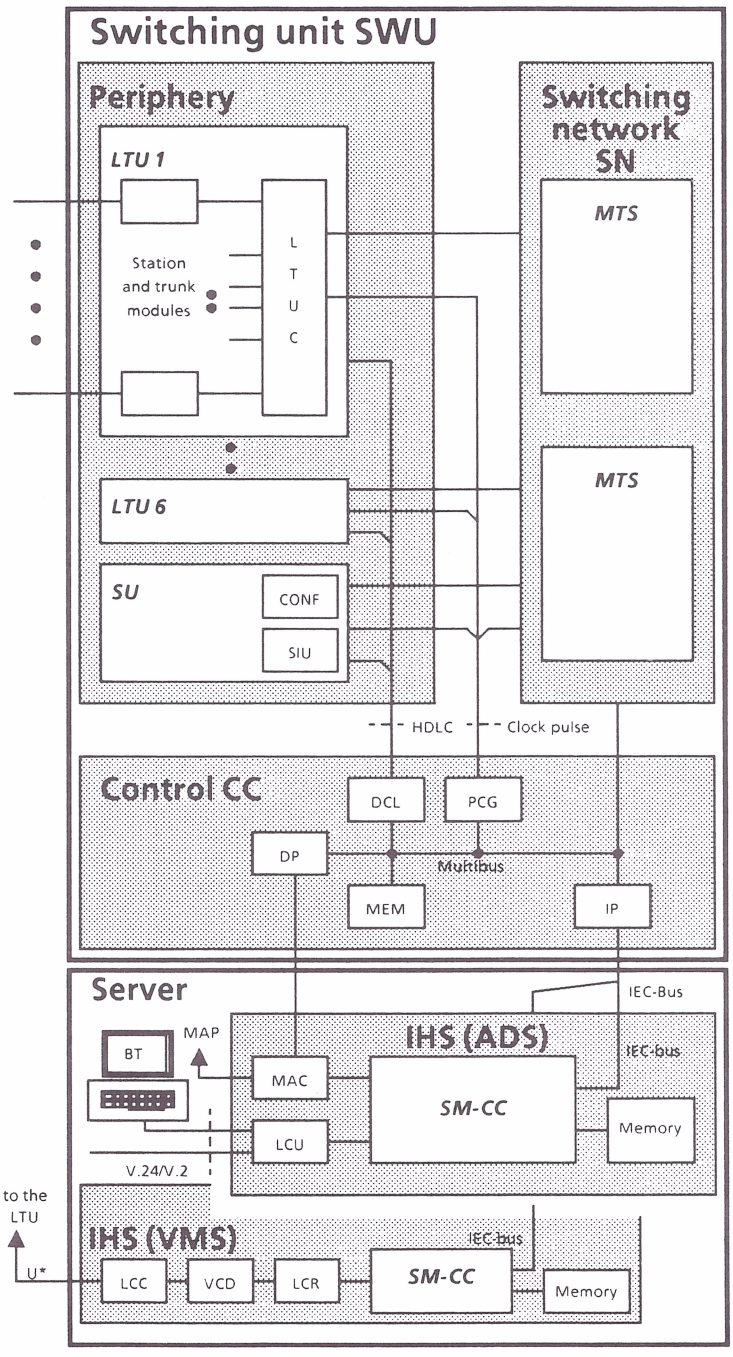


Fig. 1-15: Block diag. of Hicom 300 ≤960 ports

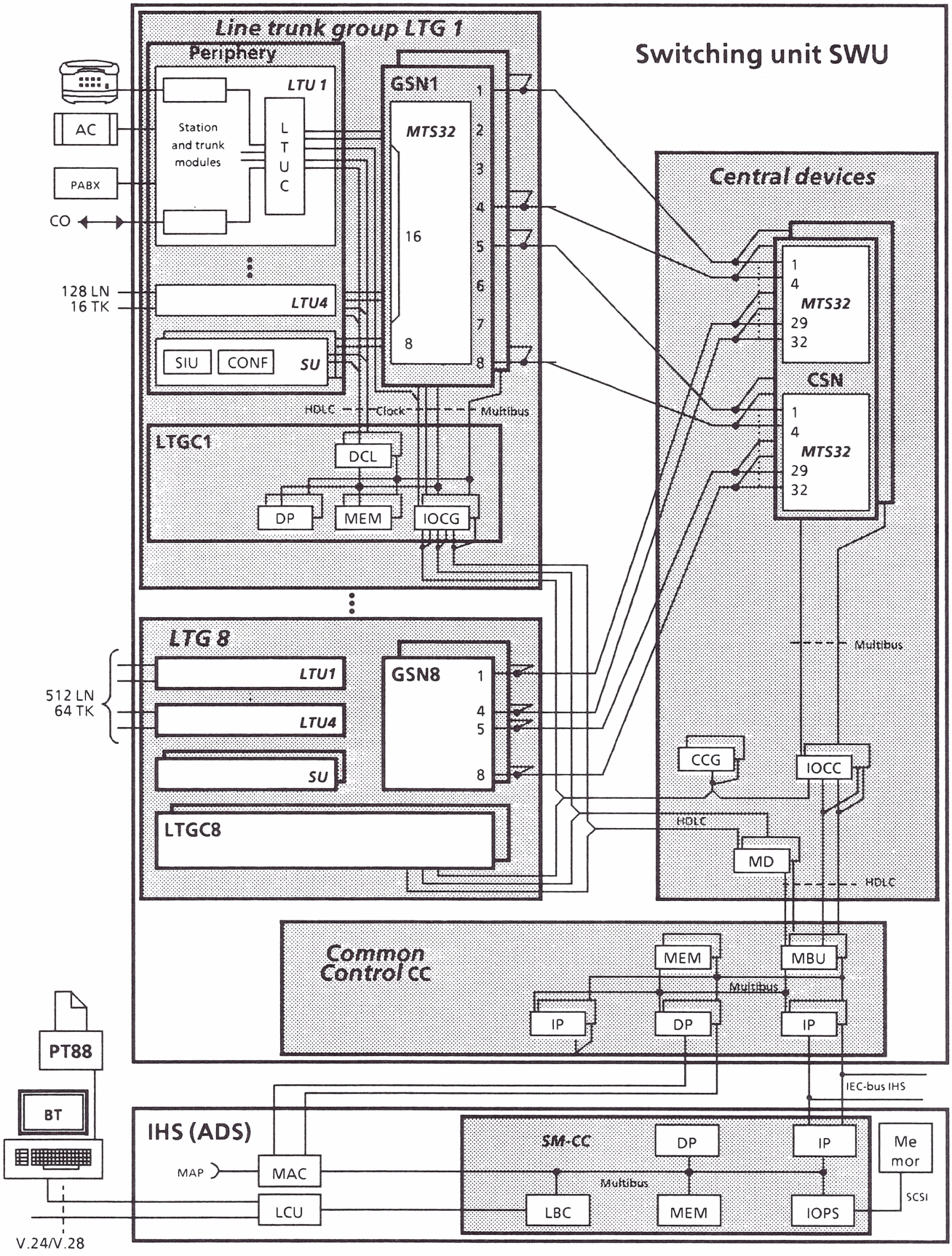


Fig. 1-16: Block diagram of the Hicom 300 system with ≤ 5120 ports

2 Hardware technology and design

2.1 Hardware technology

The technology of the Hicom 300 ISDN communication system is characterized by the use of *telecom chips* in the periphery and the switching network and by powerful *processors* and *memories* in the control area.

These chips are supplemented by standard componentry featuring ALS technology. Small-type relays for switching the ringing and feeding currrent are used at line interfaces.

Both hard disks and floppy disks are used for storing large datasets.

The following technological features have been employed in order to develop future-oriented and cost-effective communications systems:

- The use of highly integrated components (VLSI) with matching functions has enabled the implementation of optimally designed compact systems.
- The use of standard interfaces allowing incorporation of technological innovations without affecting the system architecture.
- The use of microprocessors in all system units permits flexible adaptation to differing applications and reduces specialized hardware requirements.

Examples of various state-of-the-art applications in the Hicom 300 system:

Telecom chips

- For analog ports (lines or trunks) the voice signals are converted to digital 64-kbit/s channels using the signal processor codec and filter SICOFI; the use of a digital filter in a programmable signal processor permits flexible adaptation to different national and international transmission requirements.
- Analog and digital connection modules and the modules of the service unit SU are connected to the PCM switch and control via a standard interface, the peripheral board controller PBC. The chosen form of the interface allows the incorporation of technological upgrades without disruption of the system architecture.

Switching network

- All the time stages in the switching network are built from modules of the same type. The digital time switch MTS provides non-blocking switching of the 64-kbit/s channels through a PCM switching network. The high degree of integration of the MTS chip allows a time switch for 32 x 32 = 1024 channels to be concentrated on 2 PC boards.

Memories and processors

- The main memory (programs and data) of the central processors is made up of dynamic RAMs. The VLSI memory chips (256 kbit) - supported by high-integration controller chips for addressing and error correction - enable a packing density of 2 Mbyte per main memory module to be achieved.
- In the central processing area the 8086 or the instruction-compatible, high-power microprocessor versions 80186, 80286 and 80386 are used. The addressing volume and performance of this family of processors cover the entire range of system capacities.

2.2 Design

The construction of the Hicom 300 ISDN communication system is based on the time-proven SIVAPAC® system.

The components are mounted on **PC boards** (double-row etched multilayer boards). The PC boards are of the plug-in type with two 60-pt. clip connectors, which makes maintenance and system expansion work considerably easier.
A **shelf** accommodates the PC boards; its backplane provides the electrical connections between the PC boards.
Shelves are differentiated according to their configuration with PC boards depending on their functions.

- Shelf for periphery LTUS (Hicom 300)
- Shelf for common control CC (Hicom 300)
- Shelf for power supply PS (Hicom 300)
- Shelf for integrated Hicom server (Hicom 300)
- Shelf for peripheral memory of the servers DS (Hicom 300)
- Shelf for group control and group switching network GP-GSN (Hicom 300 with ≤5120 ports)
- Shelf for central devices IOC-CSN(Hicom 300 with ≤5120 ports)

The connecting circuit PC boards in the peripheral equipment shelf form the interface to the outside environment for external connections. Depending on how it is equipped with analog or digital circuits, a peripheral equipment shelf offers up to 160 ports, which enables , for example, a maximum of 100 stations and 60 trunks to be connected.

While the Hicom 300 system with ≤5120 ports uses four peripheral equipment shelves in one cabinet and the Hicom 300 system with ≤960 ports uses three, the Hicom 300 system with ≤256 ports has two of these shelves.

This arrangement allows **Hicom 300 with ≤256 ports** to be accommodated in only one cabinet, the so-called basic cabinet C180 B. This basic cabinet provides built-in trays in the side panels in which one or two hard disk drives can be installed with their controller, the power supply modules, support batteries, inverters, the connecting panel, and the modems for connection to a data processing system or telecontrol (remote operation and/or remote administration). The cabinet has casters for mobility and can be placed directly in front of the wall-type distribution frame to ensure a space-saving arrangement. A second mobile cabinet can be supplied for expansion with additional service modules.

With **Hicom 300 with ≤960 ports** the shelves, power supply equipment and the necessary cabling are housed in up to four cabinets according to the configuration and capacity of the system. These cabinets contain the switching equipment, the integrated servers, the power supply and the main distributor.

With **Hicom 300 with ≤5120 ports** the accommodation of the switching equipment, the integrated servers, the power supply and the necessary cabling in the cabinets allows an easy and flexible expansion from the minimum to the maximum configuration. Hence, Hicom 300 with ≤5120 ports in the configuration for 3000 stations comprises 15 cabinets, with a requirement of 8 peripheral cabinets CAB P and 4 main distribution frame cabinets CAB M2. If modems or additional servers are used, further system cabinets (CAB D1 or CAB S1) are possible.

Easy-to-service, solderless twin terminal connections are used for the **main distribution frame** (MDF) in the CAB M cabinets.

The system's **power** is drawn from the ac power network. The nominal system voltage of –48 V is obtained from the ac voltage via one or more charging rectifier units switched in parallel, depending on the capacity of the system. Two modes are possible, i.e. ac power only or ac power/battery operation (parallel standby mode). The advantage of the ac power/battery mode is that in the event of an outage, power is maintained by means of the battery without operation being interrupted. In Hicom 300 with ≤256 ports power outages of up to four minutes length are bridged by the support batteries if no long-term battery is provided.

The following figures show the various shelves in the cabinets of the individual systems, where they are configured according to their function in the system.

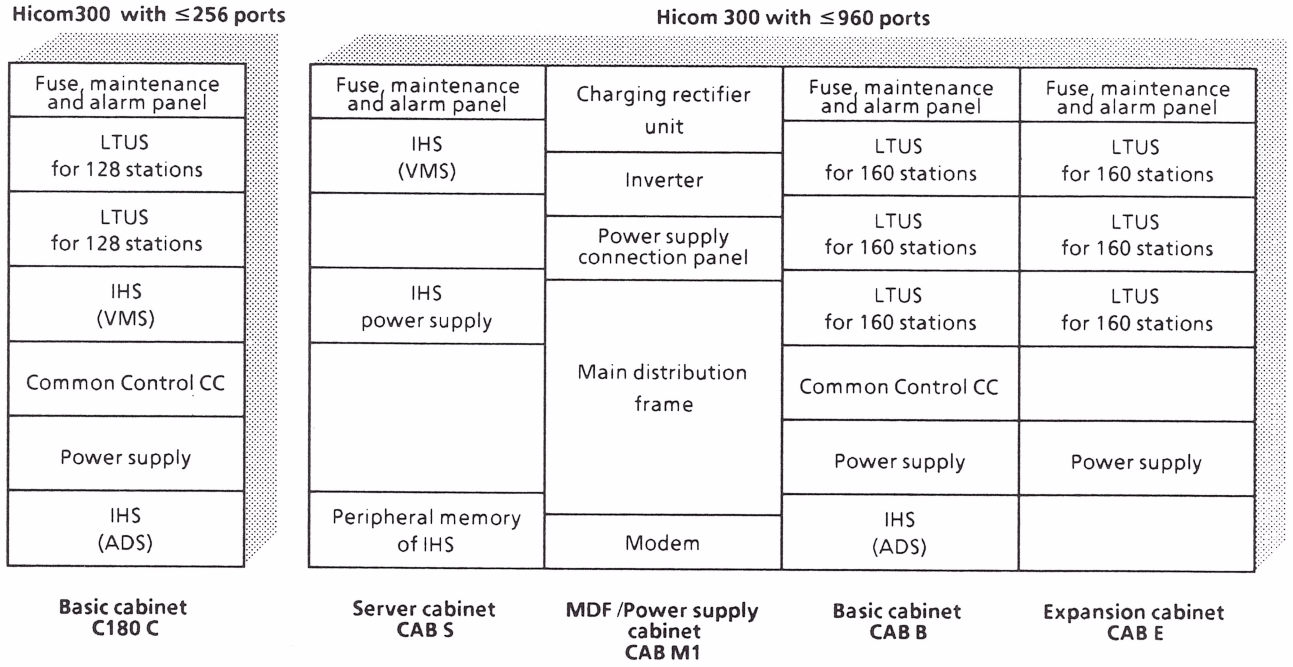


Fig. 2-1: Hicom 300 with ≤256 and ≤960 ports

Example of cabinet layout (incl. servers, power supply and MDF) for a configuration with . 180 or 600 stations max

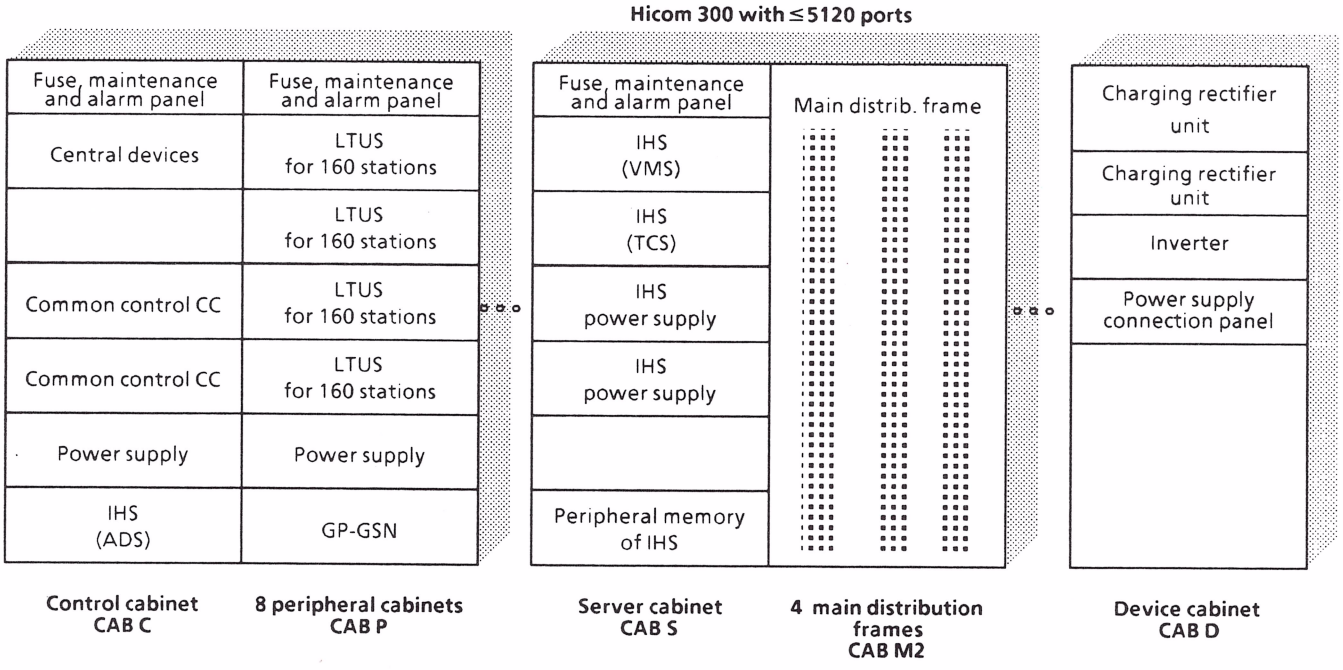


Fig. 2-2: Hicom 300 with ≤5120 ports

Example of cabinet layout (incl.servers, power supply and MDF) for a configuration of. 3000 stations

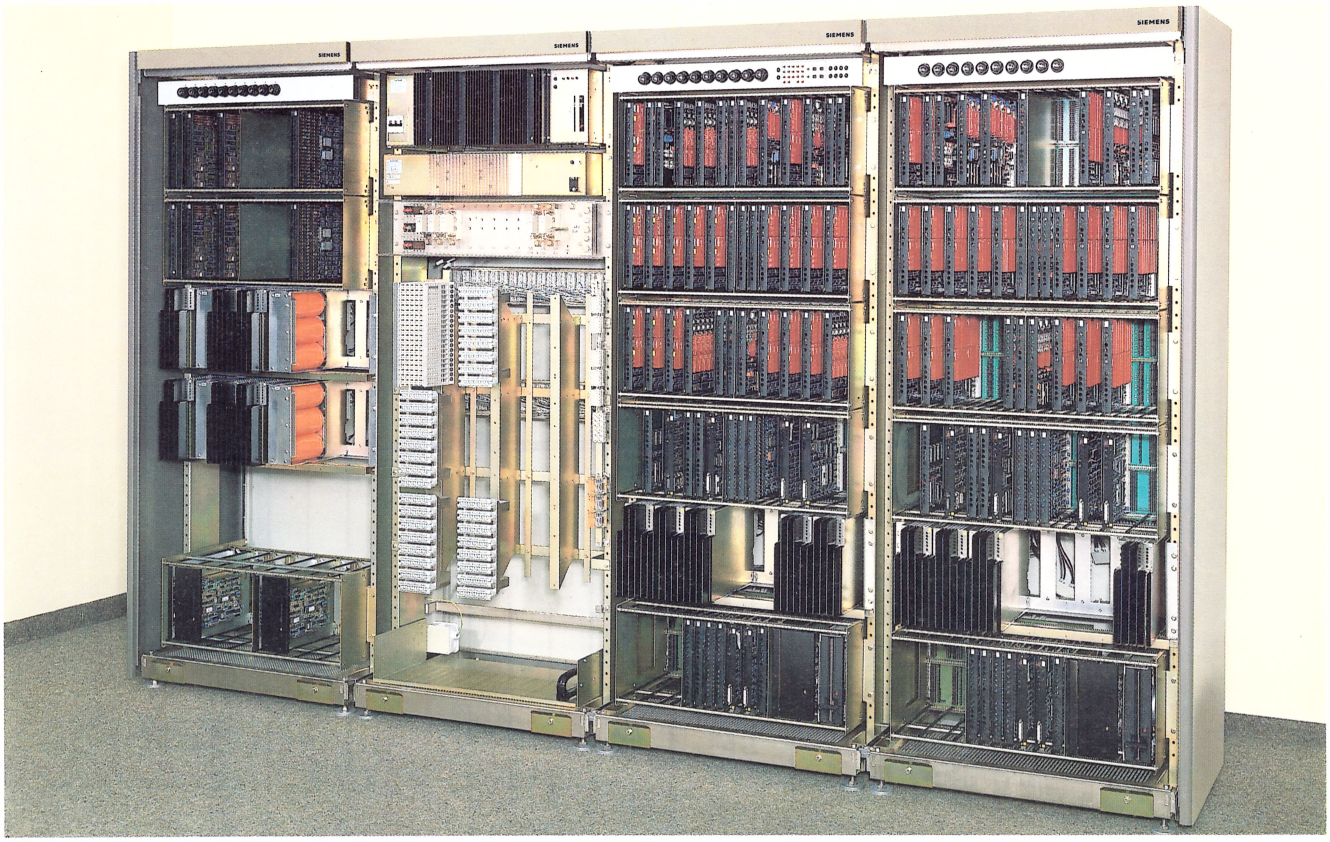


Fig. 2-3: Hicom 300 System with ≤960 ports

Example of cabinet layout (incl. voice mail server and MDF) for a configuration with 600 stations

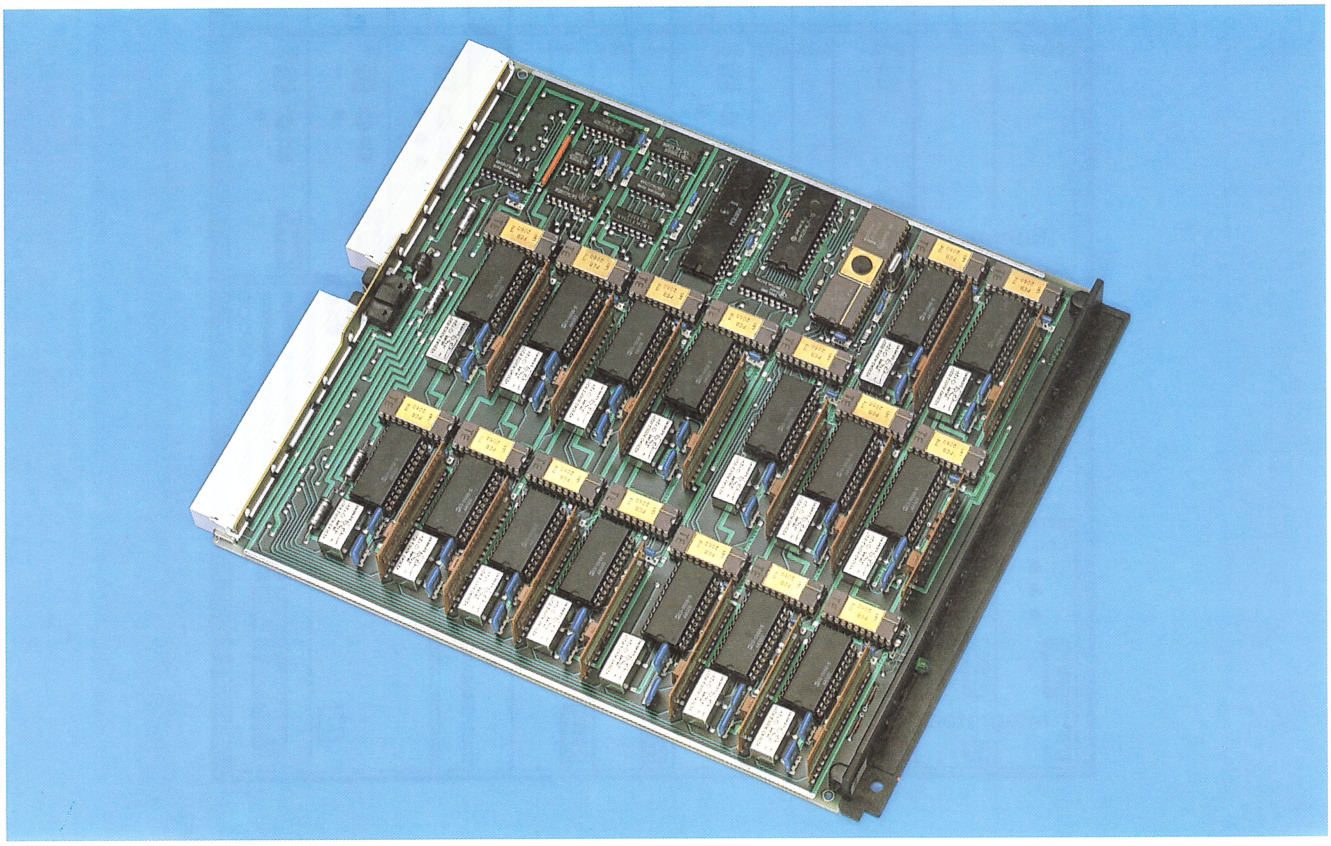


Fig. 2-4: SLMA Module

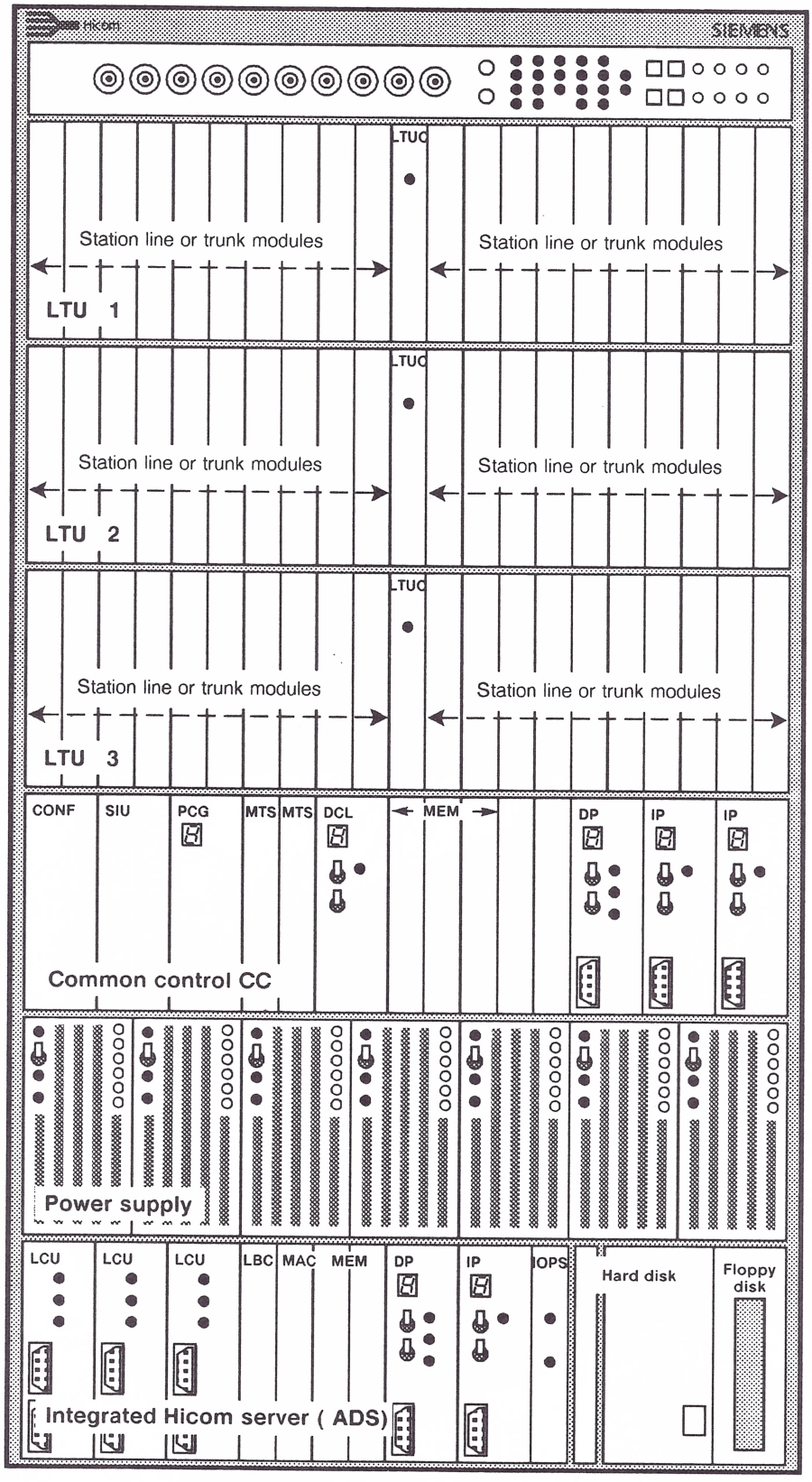


Fig. 2-5: Example of module layout in basic cabinet CAB B for Hicom 300 with ≤ 960 ports

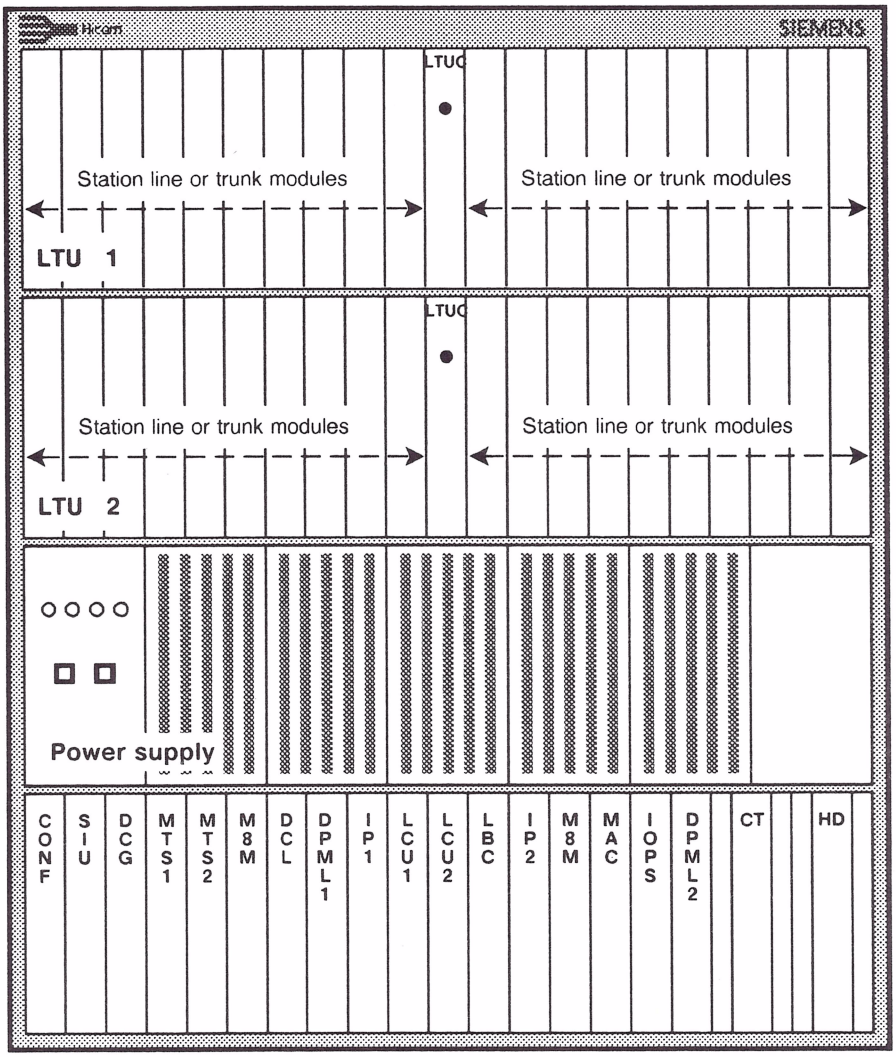


Fig. 2-6: Example of module layout in basic cabinet 180 C
for Hicom 300 system

3 Upgraded System Architecture

The system architecture of the Hicom 300 basic system has been completely upgraded by means of the concept described in the following,

3.1 General

The main features of the new system architecture are as follows:

- Cabinets with stackable units.
- Variable, customized system capacities, ranging from 1 cabinet with 4 units to 4-cabinet systems each with 6 units.
- Flexible system configurations based on the combination of different shelf units.
- Increased numbers of ports in the case of frequently used modules.
- New shelves for the periphery with increased numbers of ports.
- Combination of the functions of several common control modules and administration and data service modules to form a new unit.

3.2 System structure

The common control CC has connection facilities for a redundant unit and for integrated Hicom servers. The latter are connected to the common control by way of the IEC bus.

The common switching network is designed as a memory time switch (MTS) for 16 highways (HWYs), each with 64 B-channels.

The periphery is divided into 4 line trunk units (LTUs). Communication with the common control is processed via one HDLC channel in each case, the transmission speed being 2.048 MBit/s.

LTUs 1 to 3 are connected to the switching network by 4 HWYs each (4 MHz, 256 time slots); 2 HWYs (128 TSLs) are routed to the 4th LTU (Fig. 3-1). The 4 LTUs each have 256 external ports. In the case of connections with 64 kBit/s channels to these ports, there are no traffic restrictions for the first 3 LTUs. Each port can carry a load of one erlang. A traffic intensity of 0.5 erlangs per port is permitted for the 4th LTU. This reduction in the load is insignificant for systems with full capacity, if the 4th LTU is used primarily for subscriber line modules and analog trunk modules.

The system can accept a total load of 896 erlangs, i.e. 896 two-way 64-kBit/s channels can be switched without loss.

The common signaling unit (SIU) and the conference facility (CONF) each have access to 64 TSLs (20 add-on conferences or override connections possible simultaneously).

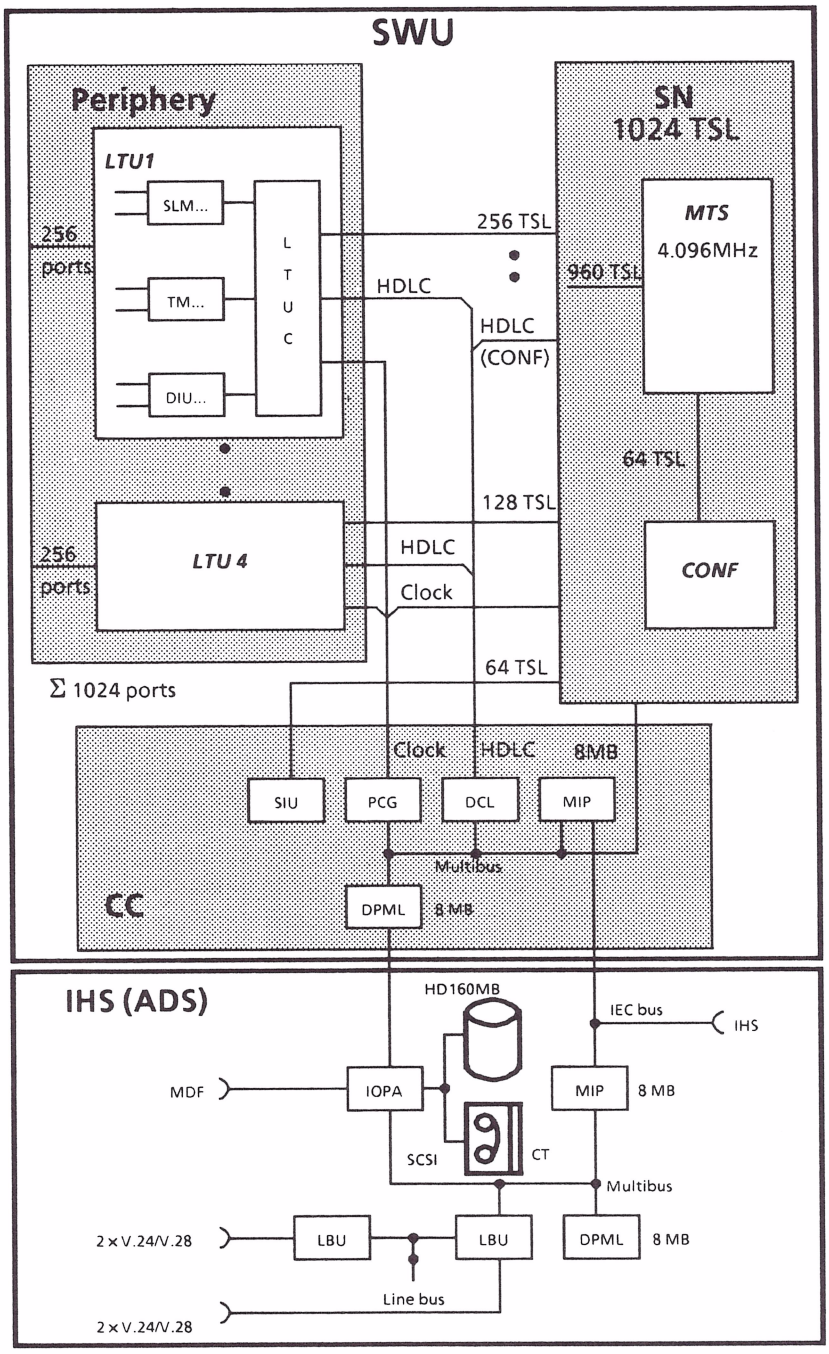


Fig. 3-1: Hicom 300 ≤1024 ports; innovated structure

3.3 Peripheral shelves

The peripheral shelf contains slots (EBPs) for 16 modules (boards) with subscriber line circuits or trunk circuits. From each of these slots 16 a/b wire pairs (256 ports in all) are led to a main distribution frame. The required fine protection for the lines is contained in the cable connector.

Access to the system side from each of the slots is possible by way of 2 HWYs, each with 32 channels (2 MHz). Both these HWYs are connected to 4 slots. Accordingly, the 4 x 16 external ports in this type of switching path unit are matched by 2 x 32 internal slots. An additional slot is used primarily to accommodate a module which does not require ports or time slots, e.g. the ring generator. However, this slot is connected in parallel with 2 HWYs and 8 ports of the first module and can accommodate a module with up to 8 lines; in this case only 8 ports can be equipped at slot 1 (EBP1).

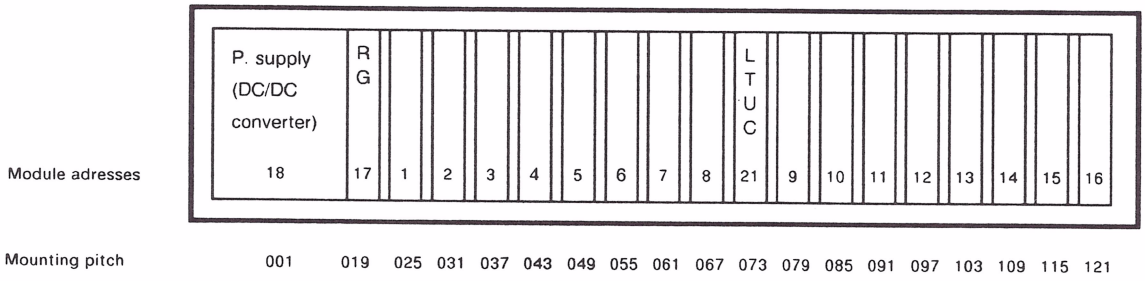


Fig. 3-2: LTU SHELF

3.3.1 Line Trunk Unit Control (LTUC)

The LTUC serves as the link between the centralized and the peripheral system units.

The LTUC module forms the interface between the DCL, the switching network and the peripheral modules in the LTU shelf. Its functions include changeover from redundant centralized system units to the non-redundant periphery and also electrical conversion and decoupling.

Additional functions of the LTUC:

- Conversion of the transmission speed of the voice channels from 4 MBit/s (to the switching network) to 2 MBit/s (to the periphery) and vice versa.
- Speech echoing of specific time slots for testing purposes in the direction of the switching network.
- Monitoring of the system clocks.
- Initialization and supervision of the ring generators.
- Generation of the resetting signals for the peripheral modules.

3.3.2 Power supply for the periphery

The shelf is powered by a DC/DC converter which is connected in the same manner as a module and is in direct contact with the backplane. Operating states are indicated by way of LEDs and are signaled to the system. All voltages can be switched on or off directly at the converter by means of a central switch.

3.3.3 Integrated Server Extension Shelf (ISEC)

This shelf is used to accommodate the line periphery for servers and when operational is connected to the integrated Hicom Server (IHS in the common shelf CCS).

The ISE shelf can be configured flexibly in the place of a SWU peripheral shelf and is connected to the line bus of the server by way of a connecting cable.

The ISE shelf can contain a maximum of 4 line units (LU) or a maximum of 5 V.24 modules (LBU), each with 2 V.24 interfaces.

Line units with U* coupling to the switching unit are used.

Depending on the server service, a line unit (U*) consists of the modules:

LCR + LCC + VCD for LU voice

LCR + LCC + RAX for LU text/data

LCR + LCC + VCD + 2×FCD for LU fax

A maximum of one LU fax can be mounted in the ISE shelf.

- If the ISEC is connected to the integrated Hicom Server in the CCS, the second LBU in the CCS cannot be used (cable to LBU 2 or ISE only).

3.4 Common shelf (CCS)

The common control (CC) of the IHS (administration and data service ADS) and the associated power supply are contained in a shelf.

The following modules are created in the CC and ADS sectors:

- Data processor with 8-MB local memory DPML
- Interface processor with 8-MB central memory (IP + 8 MB → MIP)

In the CC:

- Switching network module with conference facility (2×MTS + CONF → MTS)

In the ADS:

- Line bus and line periphery control (LBC + LCU → LBU)
- I/O prozessor with maintenance and alarm control (IOPS + MAC + MAP → IOPA)

The interface processor (MIP) has 2 IEC bus connections. In the CC one of these is used as the connection to the IHS; the other bus is intended for the connection of a redundant control unit.

The functions of the maintenance and control panel (previously contained in the front section of the cabinet) are performed by the IOPA. The handle strip of the IOPA contains the operating status and fault displays in addition to keys for manual startup of the drives.

The backplane contains a plug for the connection of an MDF cable for signal repetition, the signaling of faults in external devices (e.g. dc-ac copnverters), and activation of trunk failure transfer (ALUM). This cable also contains 2 a/b wire pairs for test connections. The "faston" connectors in the backplane are used for connection to the a/b wires.

The trunk failure transfer (ALUM) facility is optional. Provision is made for it in the MDF.

3.4.1 Common Control and Server Shelf (CCS) (Fig. 3-3)

The CCS shelf or basic shelf contains the common switching unit (SWU) in addition to the control for the processing programs and the storage media of the system data (ADS). The shelf can also be used as a redundant control and/or supplemented with the addition of an integrated server expansion ISEC (line bus). Advance provision is made for connections for further server shelves (IHS) (VMS, TCS). The basic shelf has provision for 2 trunk modules, each with 2 V24/V28 interfaces.

In each server expansion shelf (ISEC) a maximum of 5 additional trunk modules or trunk module circuits can be controlled by the server control via the line bus cable.

The following devices with 5 1/4" format and SCSI interface are used as storage drives:

- Cartridge; 5 ▮" full height, Type PEREX HCD 75
- Hard disk; 3 ▮" half height (2×80 MB)

The storage drives, which are installed on special drive mounts, are plugged into the backplane.

3.4.2 Switching network/conference

The functions of a 32×32 time slot switching network and the features of a conference facility are implemented with the MTS module. The module is housed in the common control shelf.

Features

- Switching network functions
  - Non-blocking switching of 16 4Mbit/s speech highways (1024 time slots)
  - Single-channel connections
  - Broadcast connections for the distribution of tones/announcements

All the functions of the switching network unit are controlled by the common processor module by way of the multibus.

- Conference functions
  - Override (≤ 18 connections)
  - Camp-on (≤ 28 connections)
  - Conferences with 3 parties (≤ 18)
  - Variable attenuation and noise suppression for individual users
  - Generation of audible tones and tone rhythms for override, camp-on, conference

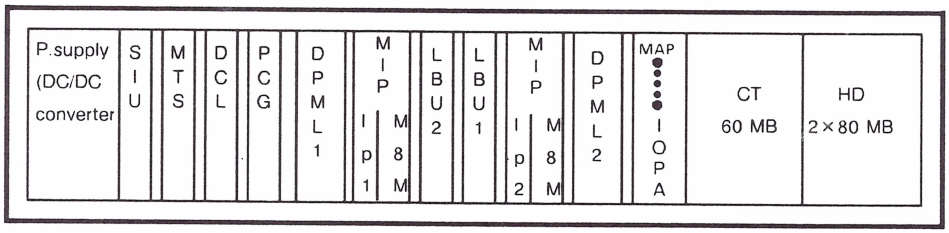


Fig. 3-3: CCS SHELF

3.4.3 Memory/Interface Processor (MIP)

The MIP module combines the functions of the interface processor IP and those of the memory linked to the multibus.

- Provision is made for partial expansion with 2-Mbyte storage capacity; provision is also made for the use of 4-Mbit chips, with the result that if the devices are available a memory capacity of 16 Mbyte is achieved.
- By means of two IEC bus controllers, the MIP module can function as a cross channel and as a server IP. For this dual function two IEC bus connectors are required in the shelf.
- The EPROM capacity is 128 KBytes; the capacity of the local RAMS is 64 KBytes, comprising static memory chips. Provision is made for the 80C186 microprocessor, which can be operated in the module with a maximum working clock frequency of 12.5 MHz.
- The front strip of the module contains a 7-segment display which indicates the different operating states.

3.4.4 I/O Processor and Alarm Control (IOPA)

- General:

  The IOPA module is a multifunctional device.

  Functions:

  - Activation of SCSI drives
  - Fault-free coupling of SCSI drives for test and maintenance purposes
  - Signaling of operating states and alarms
  - Battery-supported clock
  - Keys: LDH: Load cutover system (from cartridge)
    CT: Control and interrogation of IOPA operating state
  - V.24 monitor interface for trace and control purposes.

- Design:

  The IOPA module features:

  SIVAPAC module format, 2 rows in length, equipped primarily with SMD devices, suitable for 25-mm mounting pitch.

  Accessible on front strip:
  7-segment display
  2 keys (LDH, CT),
  50-pole connector strip (SCSIA)
  25-pole spring contact strip for the V.24 monitor connection.

- Hardware interfaces:

  Multibus - as IOPS

  SCSI bus permits the connection of up to 7 SCSI drives
  2 means of connection:
  - directly via cable to SCSI backplane connector
  - transparently (buffer amplifier) via cable to SCSI front connector for fault-free connection of SCSI devices (SCSIA).

  V.24/V.28 25-pole plug for monitor connection.

- Signaling and display of alarms:

  Alarms are signaled on the 7-segment display of the IOPA module. They are subdivided into 4 categories as follows:

  - Peripheral alarm PAL
  - Trunk failure transfer ALUM
  - System alarm SYS
  - Central alarm ZAL

  By means of relays, these 4 types of alarms can be forwarded to other locations and then repeated.

- Keys: "LDH", "CT"

  By actuating

  - "LDH" cutover system can be loaded (loading from cartridge)
  - "CT" test and/or control functions can be activated.
  - "LDH" + "CT" (simultaneously) an NMI (non mask. interr.) is initiated in the IOPA µP. The interrupt leads to RESTART but **not** RESET.

3.4.5 Line Bus Unit (LBU)

The LBU module offers 2 system interfaces (line bus, multibus) and 2 user interfaces V.24.

If 2×V.24 is not sufficient, an additional LBU (with a further 2 x V.24) must be connected at the line bus interface (see Fig. 3-1).

3.5 Power supply

Use of a common power supply unit (CRUHC cf. Fig. 3-4) for the overall system and DC/DC converters separately for each shelf.

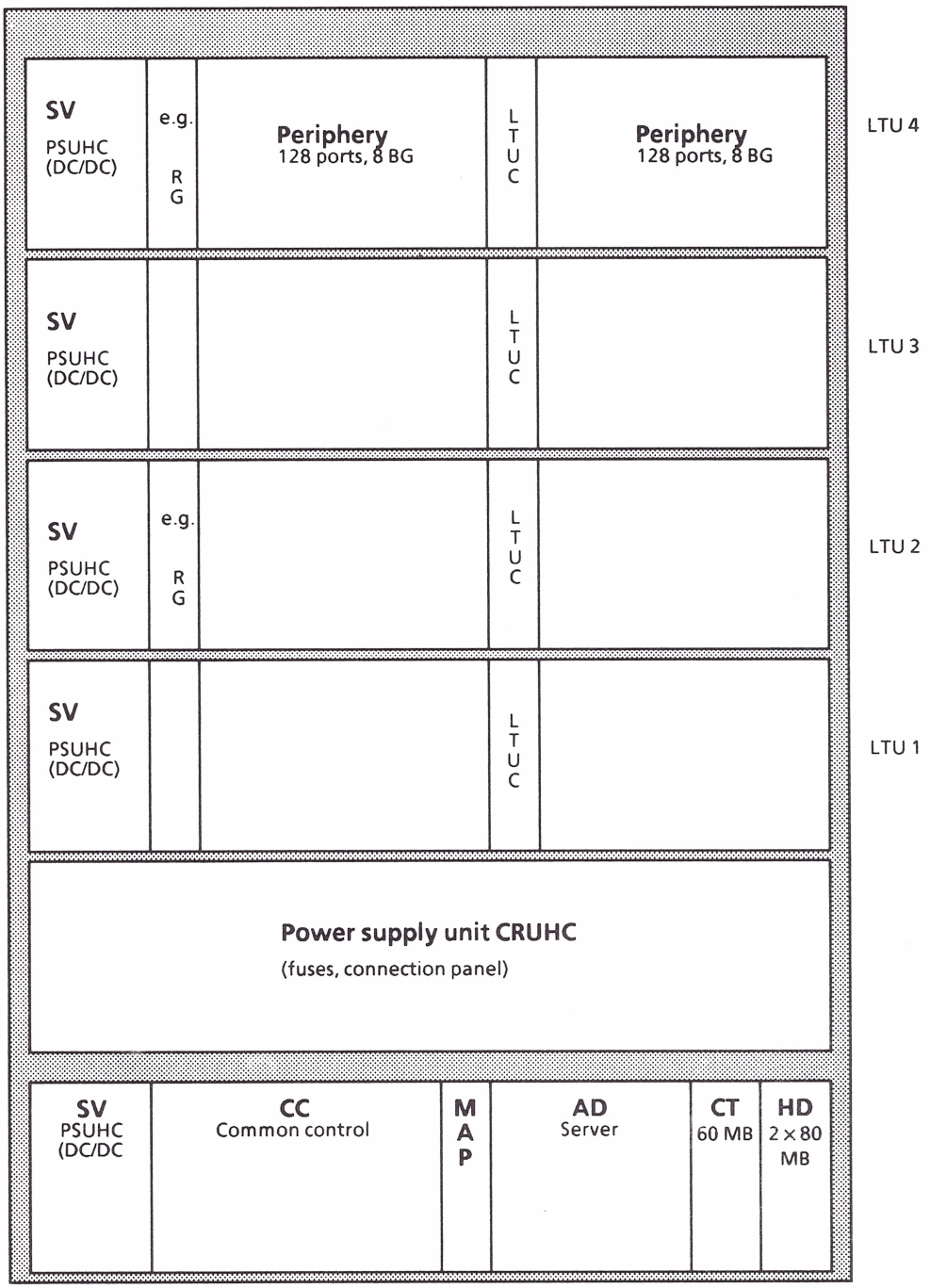


Fig. 3-4: CAB HC

3.6 Design

Hicom 300 with its upgraded system architecture is designed with a new cabinet configuration, the so-called stacking method. A maximum of 6 SIVAPAC shelves have to be installed (Fig. 3-4). There are 2 methods of cabinet installation:

- free-standing (front and rear accessible)
- wall mounting.

With a full equipment complement, the power which can be dissipated as heat by means of free convection is 1300W (without the componentry becoming overheated).

3.6.1 Design variants

With the stacking method of cabinet design, the vertical installation components are manufactured with one, four or six mounting units (HE).

This means that cabinet heights for the installation of four, five or six SIVAPAC shelves can be achieved. Initial cabinet capacities can be expanded upward to a total of six shelves.

The individual components (shelves) can be combined in stacks on a flexible basis (Fig. 3-5, 3-6).

In a full-capacity system the cabinet contains 4 LTU shelves, the control shelf and the power supply. For variants with supplementary components a certain minimum configuration is necessary (Fig. 3-7).

Cabinets with fixed equipment complements for specific functions are not specially defined.

The basic configuration of the system comprises the combined common control with IHS (CCS), the peripheral shelf (LTUS) and the charging rectifier (CRUHC). These 3 basic shelves can be expanded with the addition of further LTU shelves, integrated server equipment (ISEC), data network terminations (DNE), modems or dc-ac converters (WR) to form 6 mounting units (HE).

Apart from the abovementioned components, magnetic tape units (MTU) and other server controls (IHS in the CCS) can be incorporated in the second and third stacks.

The main distribution frame (MDF) must be considered separately. Each MDF at the customer's premises can be connected as a separate item of equipment.

Fig. 3-8 contains examples of system configurations.

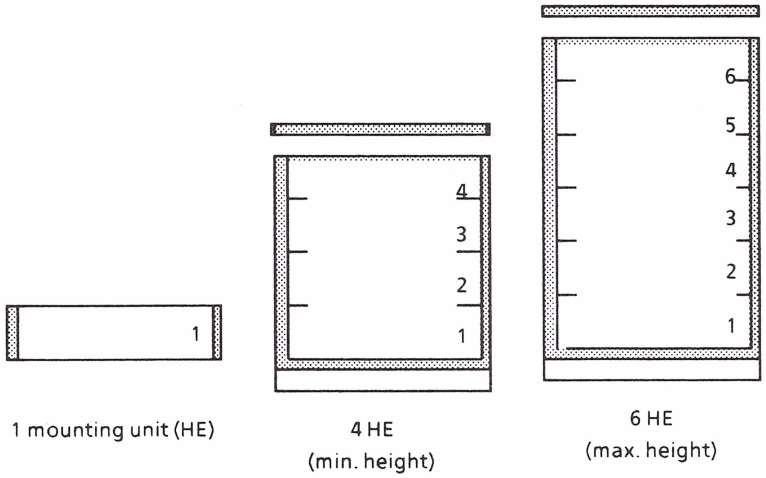


Fig. 3-5: Stacking heights

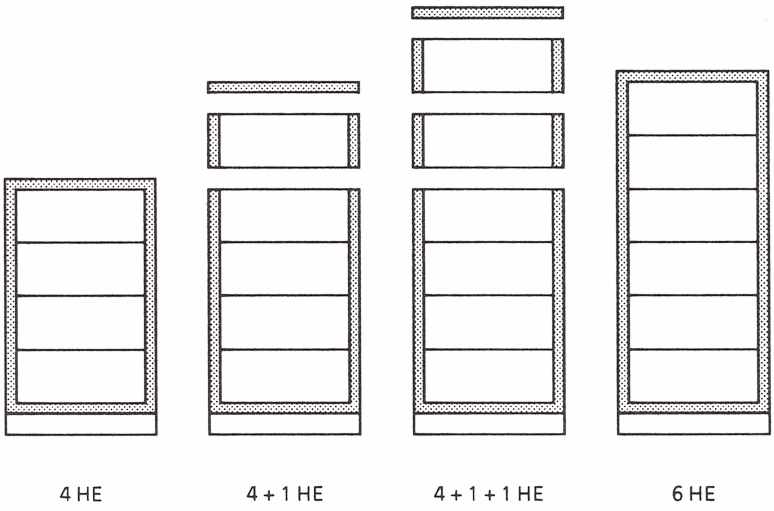


Fig. 3-6: Installation heights

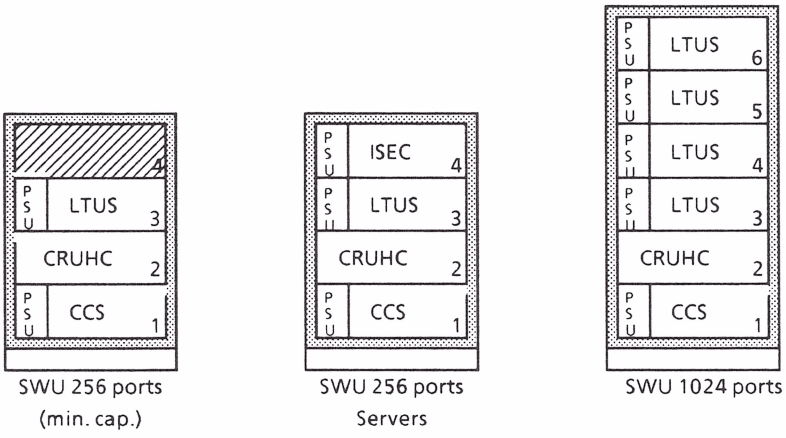
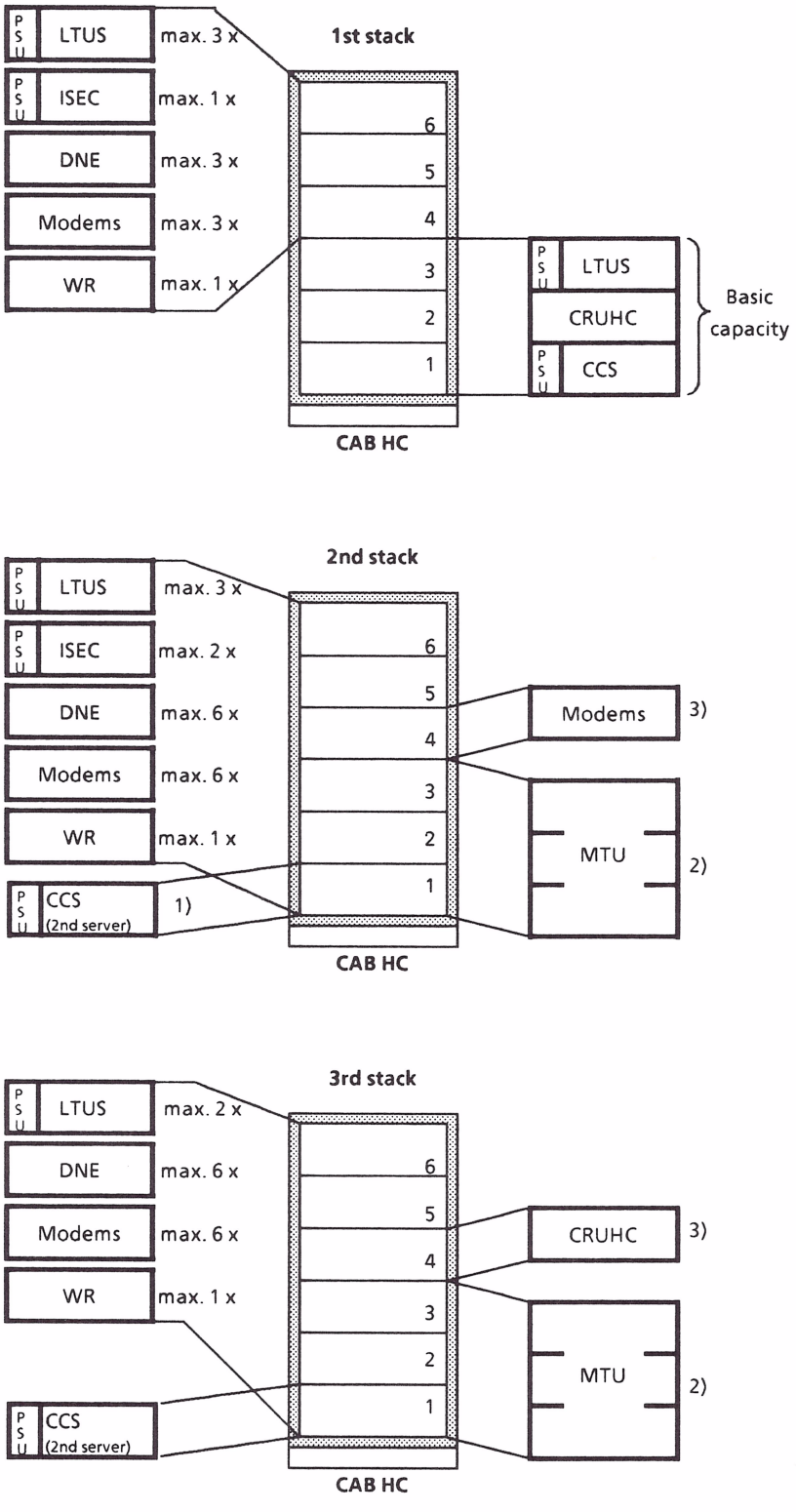


Fig. 3-7: Examples of system layout



1) only second server in one frame (without duplex)
2) MTU always in mounting level 1-3
3) only as second device

Fig. 3-8: Examples of configurations

4 Operational features

Operational features such as the *administration and maintenance system* and the *dependability system* ensure the integrity of the service features as well as the high degree of availability of the Hicom 300 system. In addition, such facilities as the switching network and common control may be duplicated (duplex mode) as from a specific capacity stage of the Hicom 300 system .

The **administration and maintenance system** performs the functions required to put the system into service and to maintain operation.

The **dependability system** ensures the highest possible degree of availability, even in the event of system failures. It also contributes to accurate and rapid fault removal by providing detailed fault information.

In the **duplex mode** all functional units except the line periphery are duplicated; the duplicated parts are operated in the standby mode. This means that both functional units are supplied with the same data. If a failure occurs, operation can be switched to the standby functional unit without affecting the system or existing connections.

4.1 Administration and maintenance system

The tasks of the administration and maintenance sytem are:

- putting the system into operation
- administration
- maintenance
- traffic metering.

To put the system into operation or to carry out maintenance and administrative tasks, the following means of communication are available to the system operator:

- service terminal (local and remote)
- NMC (in connection with networked systems)
- call processing terminals
- functional switches, displays and service plugs on PC boards for special functions.

The processing of individual tasks by the administration and maintenance system is initiated by entering MML commands (commands in man-machine language), which call up *administration and maintenance operations* (AMOs) in the sytem:

Cutover AMOs

- transfer of system program (SP) on to hard disk
- module startup
- system startup

Administration AMOs

- data memory generation/regeneration
- system configuration
- customer-related data
- call charge registration (creating, changing, deleting, displaying)
- administration of the integrated server data.

Maintenance AMOs

- manual enablement/disablement/changeover of system units
- manual test jobs
- fault signaling (plain text output and signaling of error messages)
- identification of faults
- compatibility check (software-software and software-hardware).

Traffic metering AMOs

These are used to obtain system traffic data in order to make optimum use of all parts of the sytem and/or to ascertain where congestion arises.

AMO operating area

The system service terminal is the standard I/O device.

Input of all the parameters of an MML command for an administration and maintenance job is carried out in blocks (direct input) or by way of operator prompting (interactive input).

Selected operating tasks (e.g. changing user classes of service) can be performed with EMML (extended man-machine language) with the support of masks.

This involves the internal chaining of AMO commands; the user remains unaware of this procedure.

The administration and maintenance is accessed with EMML by way of codes which are protected with the aid of passwords. The AMOs and operating tasks which can be executed with the different codes can be specified on an individual basis.

4.1.1 Putting the system into operation

"Putting the system into operation" means running those processes on the sytem which are necessary for call processing operations to start. A distinction is made between cutover (initial loading) and system recovery.

Initial loading takes place after the system has been supplied to the customer; its objective is to put the system into operation for the first time, using customer-specific data.

System recovery (system restart) takes place after a power failure, for instance, or after system failure or manual intervention; the data stored in the system before it was taken out of service is re-used.

System recovery can be invoked either automatically under program control or by means of manual intervention.

4.1.2 Administration and maintenance functions

Functions necessary to modify the system with regard to its customer data are summarized under the term "administration"; functions for locating and removing faults come under the heading "maintenance".

These functions are implemented either automatically under program control or by means of programs started manually by the operating personnel, and include:

- configuration programs, which note the currrent system configuration and control the call processing operations accordingly;
- updating programs which save static system data at definable time intervals;
- all administrative and maintenance AMOs previously referenced.

4.1.3 Traffic metering

Traffic metering ascertains the characteristic size of traffic load over a defined period. It records the number of seizures per quarter of an hour for lines and teminal units, the operational readiness of the attendant console and the switching availability of the devices measured over the metering period. The data collected allows conclusions to be drawn about the time-related distribution of traffic quantities, the mean holding time and peak hour capacity.

4.2 Dependability system

The dependability sytem provides detailed information on faults, thus facilitating their selective and rapid removal. This is achieved by means of

- a dependability-oriented system structure
- the functions of the dependability sytem facilities and programs.

The dependability functions are divided into the following complexes:

- error detection
- error analysis
- error handling.

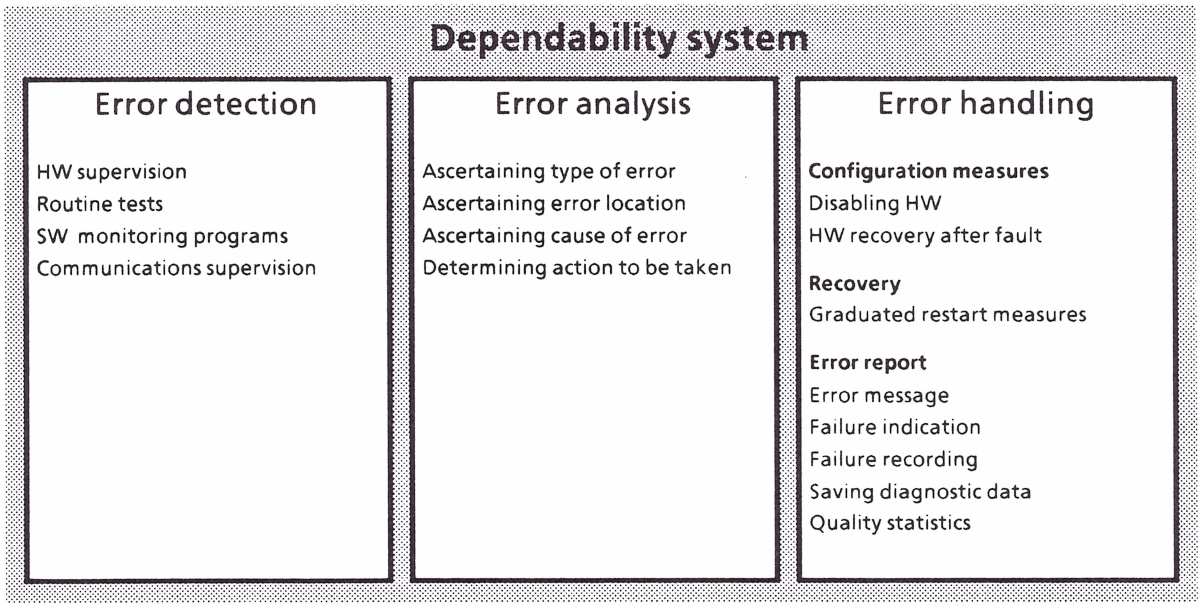


Fig. 4-1: Functions of the dependability system

4.2.1 Error detection

Errors in the Hicom 300 system are detected by both the hardware and software:

- HW supervision circuits perform two tasks:
  - They keep key system areas operational which cannot be reached by software means. Depending on the importance of the supervised functions, the supervision circuits have been designed to either generate an interrupt or to set an indication point which can be interrogated by software.
  - They support testing at such points in the sytem where testing via normal service functions is not possible.
- Routine test programs, which execute as background tests without affecting system operation, ensure that the system hardware is checked regularly.
- Software monitoring programs facilitate the detection of hardware and software errors by way of plausibility checks in the operating system and user processes.
- Suitable communication procedures enable the exchange of messages to be supervised, thus enhancing system security.

4.2.2 Error analysis

Error analysis comprises functions for

- ascertaining the type of error,
  i.e. whether an error is sporadic or stationary.
- ascertaining the location or cause of an error;
  different measures are applied here depending on the faulty function. The error can be located by means of test loops and reference measurements, for instance, triggered via message interfaces in the routine test controller, error analysis or the administration and maintenance system. The logical sequence of search steps is defined by the addressing catalog of test jobs.
- Ascertaining the remedial action to be taken;
  this determines the response to a detected error. Measures may vary between a statistical count in the case of sporadic hardware faults and a hard restart in the event of serious hardware failures or corruption of write-protected memory areas.

4.2.3 Error handling

Error handling consists of

- Configuration measures
  The changes in configuration initiated by the dependability system cause faulty equipment to be automatically taken out of operation. This is done by disabling the corresponding hardware unit. Hardware units that were disabled due to failures but which have become operational again are automatically restored to service.
- Recovery
  Recovery returns the system to a defined state; the effects of faults are removed where possible. The source of the defect itself, however, is not necessarily removed.

- Error report
  The functions of the error report are
  - reporting errors to higher-level programs,
  - accumulated failure indication,
  - logging of fault data,
  - saving diagnostic data
  - quality metering (system failure statistics).

4.3 Duplex mode

As soon as a connection goes into a protected status or a protected connection goes into an unprotected status, the call processing system CP passes on the data describing this connection to the standby control via the interface processor.

In the standby control the call processing data is kept up-to-date , and the standby switching network is set (paths are through-connected or released for protected connections).

The control which was previously in standby operation becomes active: error analysis activates the soft restart duplex in this control. Soft restart duplex disconnects all unprotected paths in the periphery and acknowledges this to error analysis. At this stage call processing can be resumed. All devices that are not involved in a protected connection and that are not blocked, are cleared down.

Error analysis triggers a hard restart or reload in the control that was previously active; this control becomes the standby control; the data and the switching network are updated.

5 Software architecture

The software of the Hicom 300 ISDN communication system is composed of the following software systems:

- system software
- support software
- application software

Most of these software systems are further subdivided into subsystems, complexes, subcomplexes, etc.

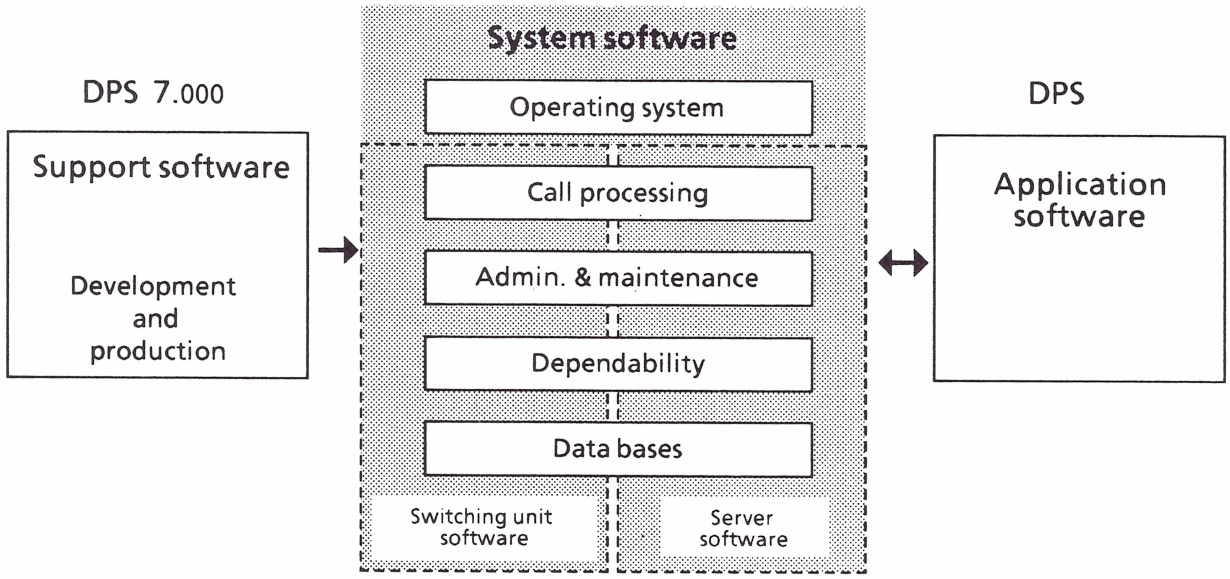


Fig. 5-1: Software architecture of the Hicom 300 system

The **system software** includes all resident and non-resident software in the system and will be considered in greater detail in the following sections. The programs are written in CHILL, based on a real-time operating system and use access routines to gain access to data not exclusively allocated to a complex. The data with its initialization and access routines is located in the data base complex and thus separated from the user programs.

The **support software** uses programs and program systems to support the preparation and production of software in all phases of development and series production. The support software serves to meet the high quality requirements placed on the entire system software.

The **application software** is run on a data processing system connected to the communication system.

Integrated configurations of this kind offer solutions to problems in the following fields of application

- integrated office communication,
- operations (in particular manufacturing),
- special branches of industry (wholesale trade, hotels, hospitals, etc.),
- remote administration and telecontrol.

It is also possible for data processing systems to make use of commands provided by the Hicom 300 system to program tasks necessitated by call charge processing, host-controlled connection setup, etc. This does not involve intervention in the system software.

Personal computers linked to the system are viewed similarly as independent systems offering performance in the form of application software.

5.1 Operating system

The operating system runs the programs of the individual subsystems within preset priorities and provides such services as resource management, communication support and timing. It is a real-time system designed on a task and job concept. Tasks are function-oriented software units which run executable code. The jobs are independent software units which run on an activity-related basis. They manage the free memory area required by tasks grouped together in a job.

Functions of the operating system:

- Task management
  (determining and monitoring priorities, activating and suspending tasks, task communication)
- Resource management
  (processor hardware, main memory, administration and maintenance equipment)
- File management
  (object management, memory management)
- Data access
- Interrupt management
  (interrupt request handling according to priorities and barring criteria)
- Timing
  (setting time of day, definable relative timers)
- Message communication
  (communication of messages across processor boundaries, sending and receiving)
- Synchronization
  (synchronization during attempts by competing tasks to access common data, use of region functions for memory access synchronization)
- Exception handling
  (task-specific and job-specific preliminary error handling)
- File access management
  (interface adaptation for all user programs)
- File management system
  (grouping together of similar files, structural handling)
- Test support
  (tracers, dump programs, degugging with SW diagnostics and on-line testing)

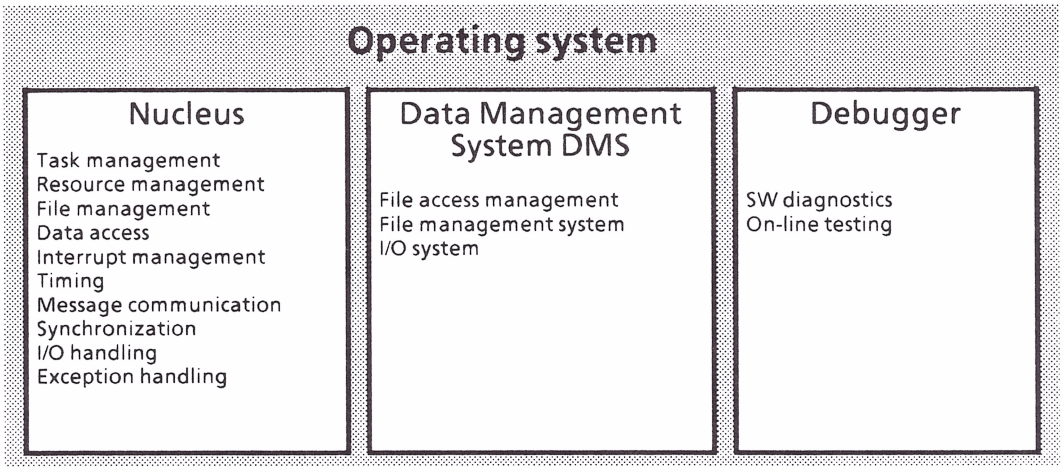


Fig. 5-2: Structure of operating system

5.2 Call processing software

The architecture of the call processing software is based on the hierarchically structured ISO Reference Model for open communications systems, which divides the communication functions into 7 protocol layers, one above the other. The call processing software in the switching unit is used for setting up and clearing down two-point and multi-point connections, and thus performs the functions of ISO layers 2 and 3, i.e. it provides transport paths within a network.

It neither processes nor stores messages - these are functions performed by the integrated servers.

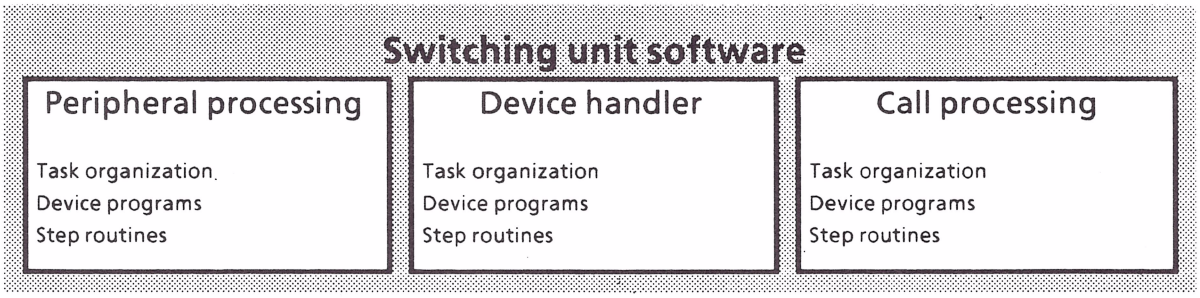


Fig. 5-3: Structure of call processing software

The call processing software can be subdivided into 3 complexes: **peripheral processing PP, device handler DH** and **call processing CP**.

The *peripheral processing PP* interfaces between the software and the hardware of the switching periphery (LTU).

There are devices with single-indication points (conventional devices) for which the peripheral processing system converts the signals from the physical level to the logical level and vice versa.

The second type of devices are those which transport messages in the D channel (devices for connection to ISDN). PP activates, deactivates and monitors the signaling channel up to and including ISO layer 3.3 for these devices.

The *device handler DH* adapts the peripheral processing interface to the ISDN call processing interface.

For the conventional devices, DH controls the signaling system and performs functions such as connecting and disconnecting tones and receivers, supervising signaling times and controlling the displays on digital telephones or the VDUs of the attendant consoles.It also allocates the individual functions (e.g. non-voice or number redial) preset by the A & M system to the key codes.

For devices supplying ISDN-standardized messages (e.g. messages from the Hicom adapter CTE) the DH reformats these messages to the internal formats of the call processing system.

For both types of equipment, the DH is also used to reduce dynamically the load on the call processing system.

Whereas it is necessary for the peripheral processing and device handlers to be able to distinguish between hardware and signaling conditions (which also defines their equipment terms) and while the DH must realize specific system solutions (tones, receivers, etc.), the *call processing system CP* serves to perform the actual functions of the user interface or interfaces to the various networks.

This means that certain signaling systems (devices as defined by the DH) are combined for the call processing system or alternatively that certain components of a Hicom MT 3510 Multiterminal are treated as separate devices.

In all three complexes of the switching software a state transition diagram is set up for each device and converted into a *step table* (CHILL programm) which executes the state transitions with the branch operations and the calls of the *step routines*.

It is essential that, apart from the ISDN interface to the device handler, each state transition diagram for the call processing system provides an internal call processing interface between the various state transition diagrams (≙ devices) totally independent of the type of device. This means that, if two different devices communicate with each other, the two different step table programs communicate with each other - but there is no need for either device to know the type of its partner device.

This non-device-specific, internal call processing interface permits the integration of future devices into the system without affecting the existing software.

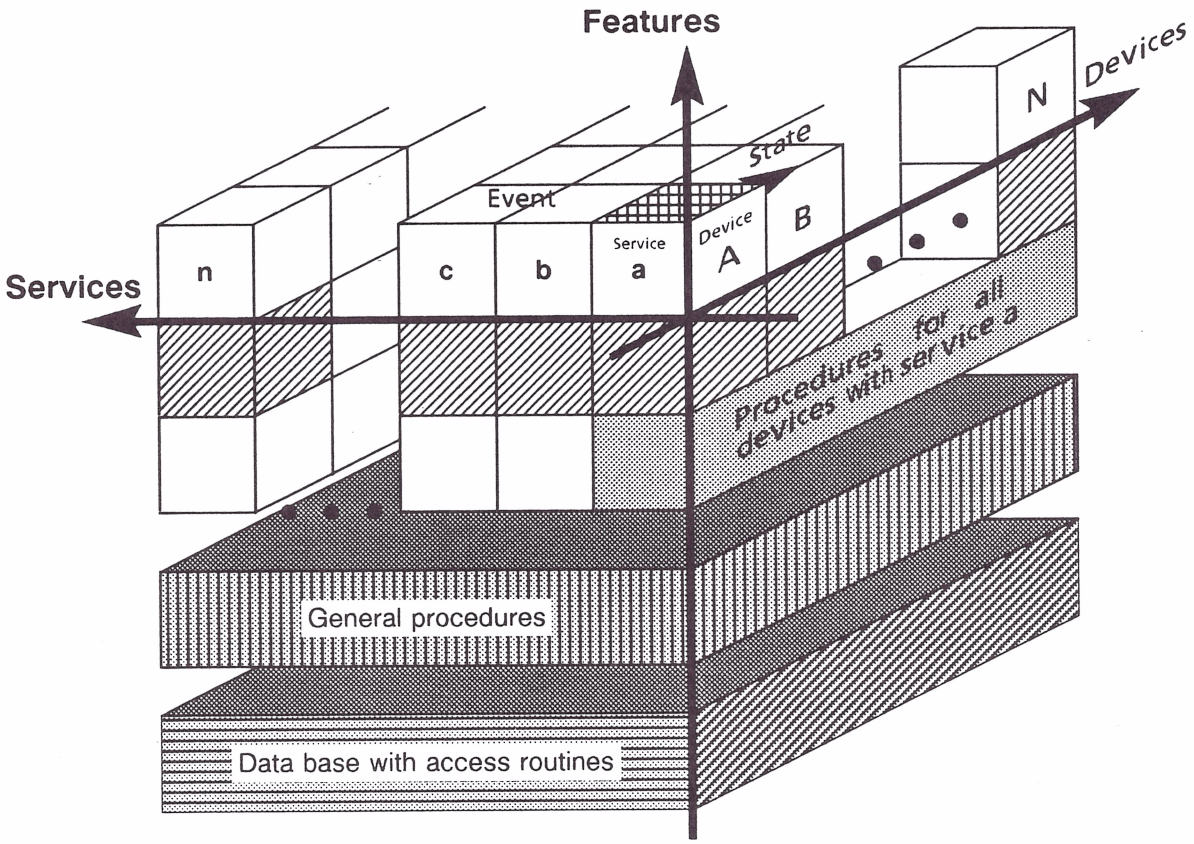


Bild 5-4: Architektur der Vermittlungssoftware

As shown in the above figure, the switching software is structured on the basis of services and devices. For each device a step table module and device-specific step routines are provided. There are also service-specific combined step routines as well as step routines which can be used throughout the switching software (ie. shared).

Below the step table level, access routines to the data base and general procedures are called up. The general procedures handle the known system-specific data (e.g. path selection), the customer-specific data (e.g. digit interpretation) or perform basic call processing functions.

The access routines are regarded as data access functions of differing complexity under the control of the data base.

5.3 Administration and maintenance software

(see also Section 4.1 "Administration and maintenance system")

The administration and maintenance software performs all the functions required for putting the system into operation and administering and maintaining the system.

The administration and maintenance complex comprises the following tasks:

- System cutover:
  - loading,
  - allocating memory,
  - initializing memory;
- System servicing:
  - configuring,
  - administering (interrogating and altering system data),
  - maintenance (testing, disabling, putting system units back into operation);
  - telecontrol
- Traffic metering.

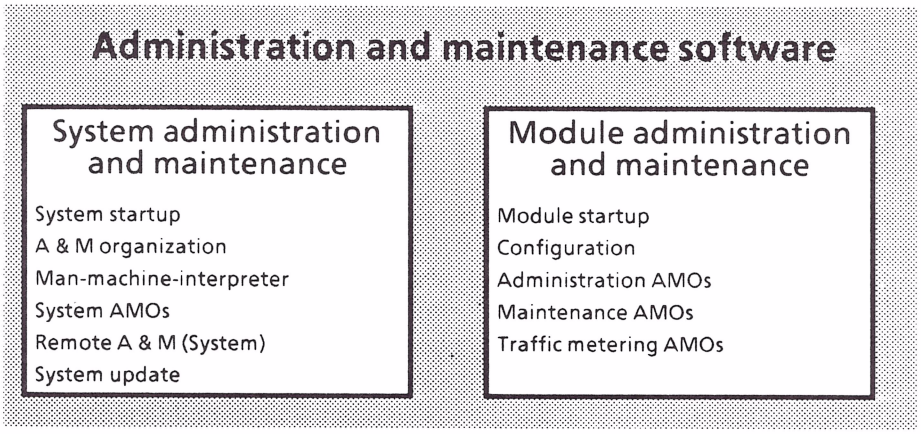


Fig. 5-5: Structure of administration and maintenance software

The software of the administration and maintenance system is characterized by ease of operation, reliability and expandability.

In addition to the A & M organization contained both in the switching unit and the servers, the varied functions of the administration and maintenance system are called up by means of A & M operations - AMOs. These operations are stored on the hard disk of the system as independent subsystems, and can therefore be exchanged without any disruption to system operation. The resultant flexibility allows functions to be expanded without difficulty.

The module administration and maintenace A & M includes the A & M for the switching unit and integrated servers.

5.4 Dependability software (see also Section 4.2 "Dependability system")

The dependability software serves to maintain fullest possible availability of the system in the event of hardware and software failures.

In detail, the dependability programs perform the following functions:

- Error detection by routine supervision or error messages from self-checking devices,
- Error analysis on the basis of error type and location,
- Error handling , evaluation of quality-of-service meters, disabling, and recovery measures.

The dependability software can be broken down into

- system dependability and
- module dependability;

the latter can again be subdivided into the dependability system for the switching unit and that of the individual servers.

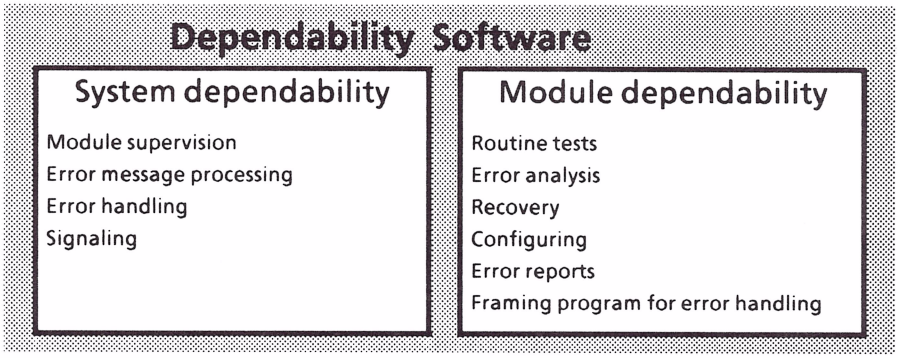


Fig. 5-6: Structure of dependability software

Each hardware module in the system (SWU, integrated servers) has its own **module dependability.** It is geared to the structure and the functions of the module in question, and executes all the dependability operations for the module in which it runs.

The dependability system also has general coordinating tasks, which go beyond the area of the module (e.g. coordination of restarts, forming the summation statement for alarm displays). These are undertaken by the **system dependability software** which is in the SWU.

5.5 Software structure of the integrated Hicom servers

The real-time operating system which is also used in the switching unit SWU forms the basis of the integrated server software. The data management system DMS contained in the operating system handles the system and user files in the various peripheral devices.

The architecture of the call processing software in the servers, like that of the call processing software of the system, is based on the hierarchically structured ISO Reference Model for open communications systems. The transport and network control functions extending to protocol layer 4 are performed within the communication management system for all users and networks served by the servers, whereas the functions in the higher-level protocol layers (5-7) are realized in the user system AS. Excluded from this are the internationally standardized telematic protocols which are also realized in the CMS. The functional structuring of the user system is guided by the device, user and message related features of the store-and-forwarding switching and mailbox functions. The switching functions which are the same for the different media are always concentrated in one software complex.

The A & M and dependability software complexes handle mainly the module-specific functions and communicate with the system's A & M and dependability programs via the system bus (IEC bus).

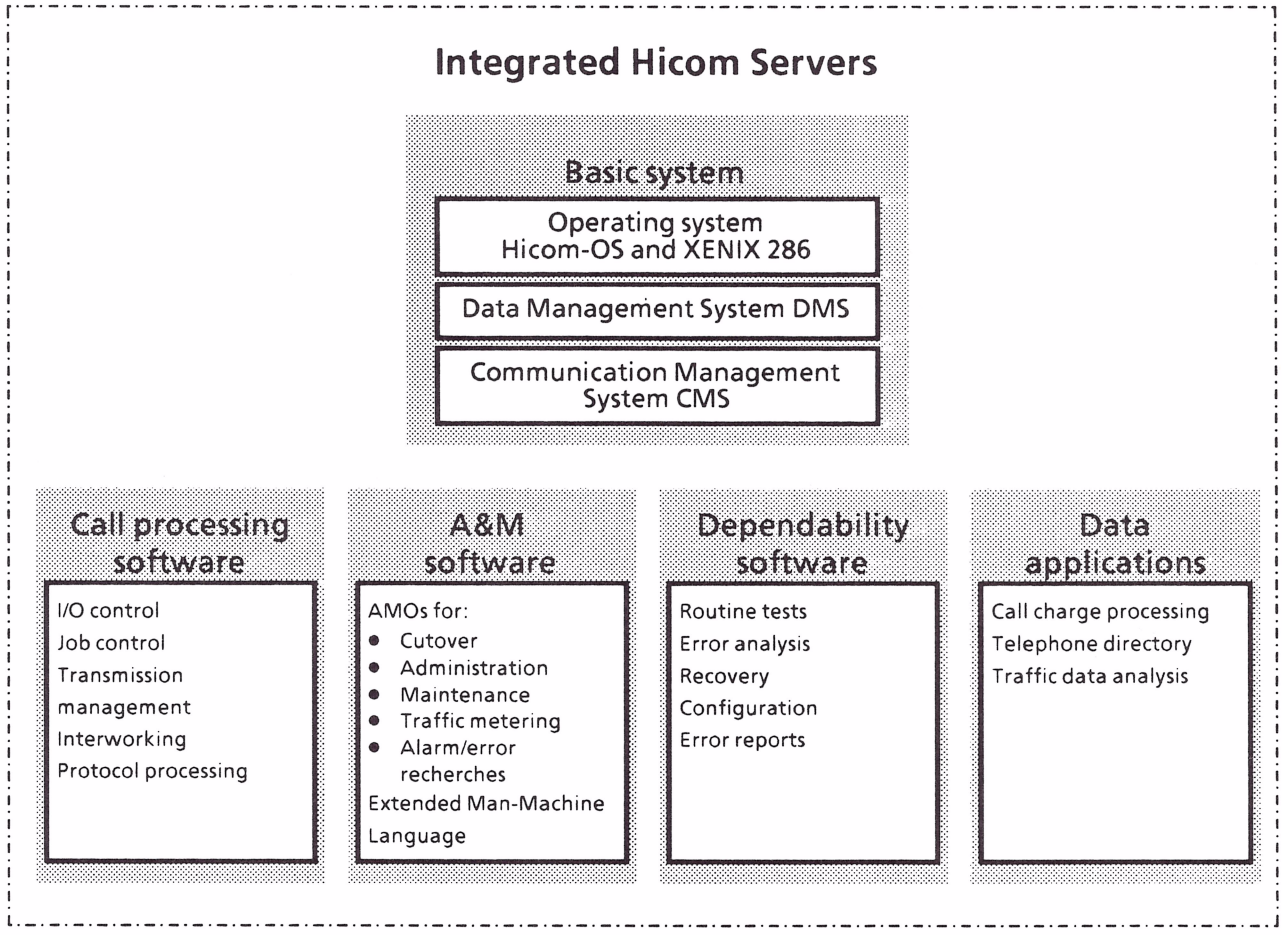


Fig. 5-7: Software structure of the integrated Hicom servers

The software structure of the integrated Hicom servers is largely similar to that of the Hicom switching unit (SWU).

Accordingly, the basic system of a Hicom server, for example, contains the same operating system Hicom-OS. In addition to the SWU, and parallel to the Hicom-OS, the Hicom servers also feature the widely-used operating system XENIX 286 as well as Data File Management (DMS) (servers only) to support the device periphery and Communication Management (CMS) to support the line periphery. Together these components form the basic system of each server.

The administration and maintenance and dependability software complexes are to be found in the Hicom servers as in the switching unit. In the servers they perform primarily the specific functions of a server and communicate with the system administration and maintenance or system dependability by way of the system bus.

The call processing software complex in a Hicom server includes, for the store-and-forward switching functions particularly, the processing of the Layer 7 protocols in the ISO reference model for open communications systems and the entire processing of mailbox-related features by the user system.

Thanks to the data applications complex, an integrated Hicom server has capabilities approaching those of a data processing system. However, with the software packages provided, not just any data is processed, but that data which is closely related to the offered call processing functions, for example:

- selective registration of call charges
- up-to-date information on all system users
- registration and analysis of the current traffic status.

5.6 Software structure of the adapted servers S 3510

The user services can be called up via the MT 3510 terminal. This includes the services of text communication, data communication and the loading services.

The basic server system covers the function complexes of communication between the Hicom 300 system and the MT 3510 terminal via the digital multi-channel connection, the dependability system for the servers and the administration and maintenance system. The administration of the individual S 3510 servers and of the Hicom 300 system is carried out via terminals that operate independently of one another.

The U* connection combines the hardware and software used for traffic via the U* interface.

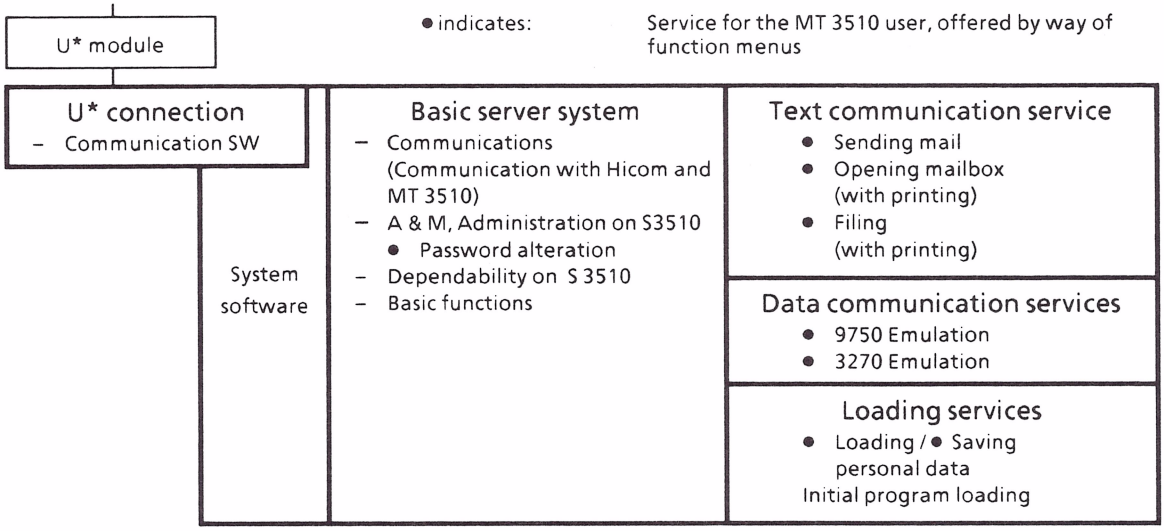


Fig. 5-8: Software structure of S 3510 Server

5.7 Data base

The data base consists of the total of all global, non-subsystem or complex-specific data and associated data access routines.

The data in the data base is subdivided into static and dynamic data. The static data may be altered and updated only by the programs of the A & M system. The dynamic data is updated continuously by the call processing software.

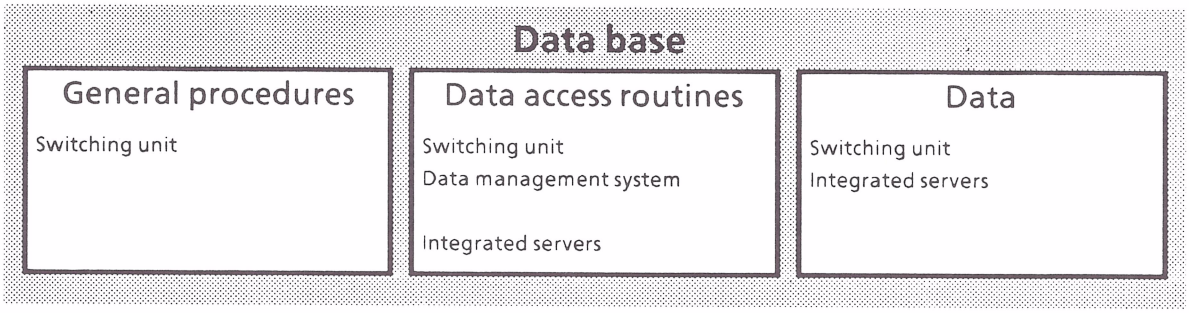


Fig. 5-9: Structure of data base

The data base of the switching unit provides a large volume of mainly device-oriented data structures with high dynamic requirements, for the sole use of the switching unit. In contrast to this the data base of the integrated servers is small in size, but these data structures are connection-oriented, are made available to all the servers and have low dynamic requirements. Access to the data base of the switching unit is provided by way of access routines.

6 Terminals

6.1 Hicom attendant console AC

The Hicom attendant console AC is used for communication between the attendant and internal/external users. Non-DID voice calls, intercepted calls and those not set up by the station users themselves are completed by the attendant. The Hicom attendant consoles can be arranged individually or in groups. If the teletex and/or facsimile services are utilized, the attendant console must be assigned an overflow position.

Visual information is displayed on the VDU in the form of text messages (12 lines, 40 characters per line) and by way of LEDs assigned to the different keys.

The attendant console, the basic version of which consists of
- a detached keyboard,
- a tilt-and-swivel monitor,
- a base unit,

can be expanded with the addition of call recording equipment (e.g. tape recording unit) and an external bell. The control panel of the attendant console has 40 freely programmable repertory keys, 29 function and feature keys, 4 setting keys, 24 display lamps and the dialing keypad.

Either a headset or handset can be connected, as required, and for instruction purposes it is possible to connect a second headset/handset to the system.

The monitor shows the call processing layout during normal operations, and a special programming layout when it is in the programming mode.

Fig. 6-1: Attendant console AC

Optional equipment available for the attendant console includes the electronic telephone directory which allows the required user data to be called up onto the screen.Convenient search criteria allow the attendant to find user names or communication numbers and department designations easily. Calls can be set up by positioning the cursor on the screen, after which dialing is carried out automatically. It is also possible to have an up-to-the-minute copy of the telephone directory printed out. An auxiliary unit for use by blind operators can also be connected (40-character Braille line).

6.2 Service terminal BT

The service terminal BT, which is used for the input and output of administration and user data, is connected to the ADS via a V.24 interface (see Section 1.3.1). Together with a printer the service terminal constitutes the communication interface to the Hicom 300 system for administration and maintenance tasks. A personal computer with terminal emulation (e.g. PC D")can also be connected in place of the standard terminal which has a 24-line screen and 80 characters per line (see illustration).

Fig. 6-2: Service terminal

6.3 Feature Telephone

Hicom set 211, set 260, set 421, set 451, set 521 and set 721

The following digital telephones are available to suit individual requirements:

Hicom set 211 Feature Telephone
– 12-key dialing pad – 8 feature keys – 4 LEDs – 24-character alphanumeric display

Hicom set 211 Feature Telephone with chip card reader
Otherwise same equipment complement as described to the left

Hicom set 260 Feature Telephone
– 12-key dialing pad – 26 feature keys – 24 LEDs – 24-character alphanumeric display Extras: – repertory dialer for up to 60 addresses – chip card reader

Hicom set 260 Feature Telephone with handsfree facility
Otherwise same equipment complement as described to the left

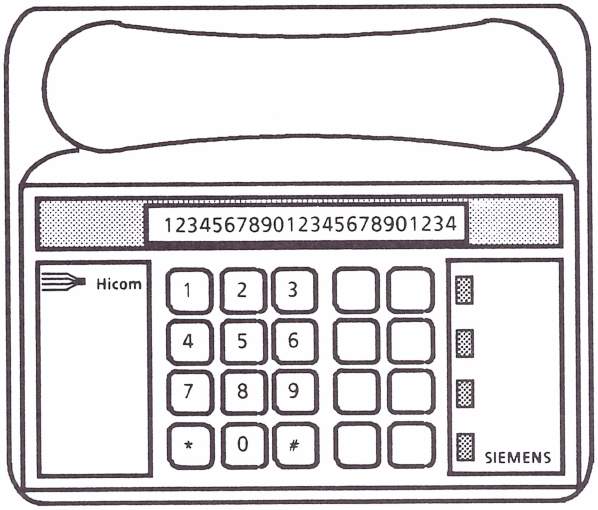


Fig. 6-3: Feature Telephone
Hicom set 211

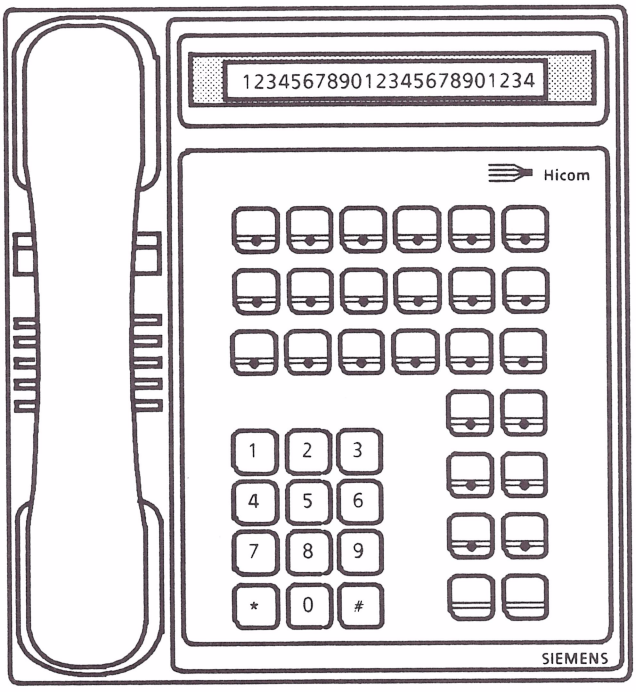


Fig. 6-4: Feature Telephone
Hicom set 260

Hicom set 421 T16 D
Feature Telephone

- Feature and status information by means of LED (red) and display
- Convenient operating and programming procedures, user prompting via display
- 16 feature keys with LEDs, incl. 5 programmable as feature, repertory or DSS keys
- Display 2 rows/24 characters
- On-hook dialing
- Connection facilities for extra earphone, second ringing unit, tape recording, desk microphone, addit. power feeding, etc.
- Extras:
  * Auxiliary unit with 42 feature keys
  * Auxiliary unit with 42 repertory keys

Hicom set 421 T24 FD
Feature Telephone

- Feature and status information by means of LED (red) and display
- Convenient operating and programming procedures, user prompting via display
- 24 feature keys with LEDs, incl. 13 programmable as feature, repertory or DSS keys
- Display 2 rows/24 characters
- Handsfree talking, open listening
- On-hook dialing
- Connection facilities for extra earphone, second ringing unit, tape recording, desk microphone, addit. power feeding, etc.
- Extras:
  * Auxiliary unit with 42 feature keys
  * Auxiliary unit with 42 repertory keys

Hicom set 410 N
Auxiliary unit

- 42 keys
- For repertory key expansion
- Connection to set 421 T16 D and set 421 T24 FD

Hicom set 410 T
Auxiliary unit

- 42 keys with LEDs for feature und repertory key expansion
- Connection to set 421 T16 D and set 421 T24 FD

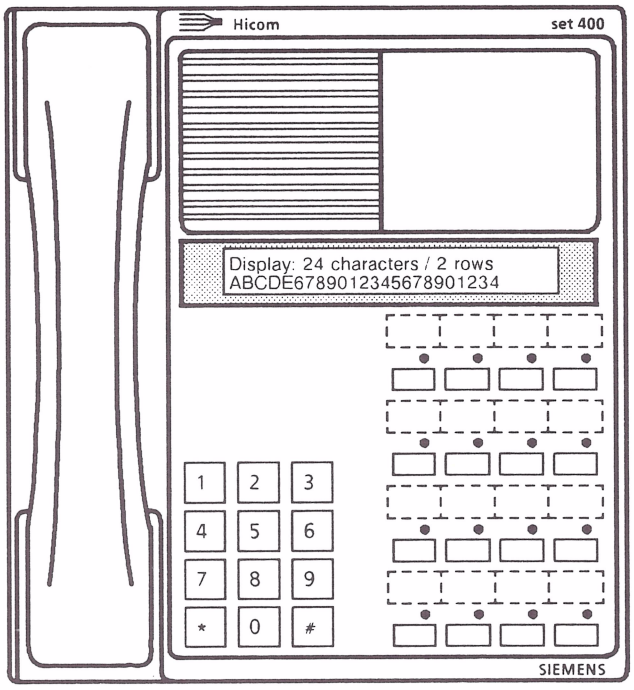


Fig 6-5: Feature Telephone
Hicom set 421 T16 D

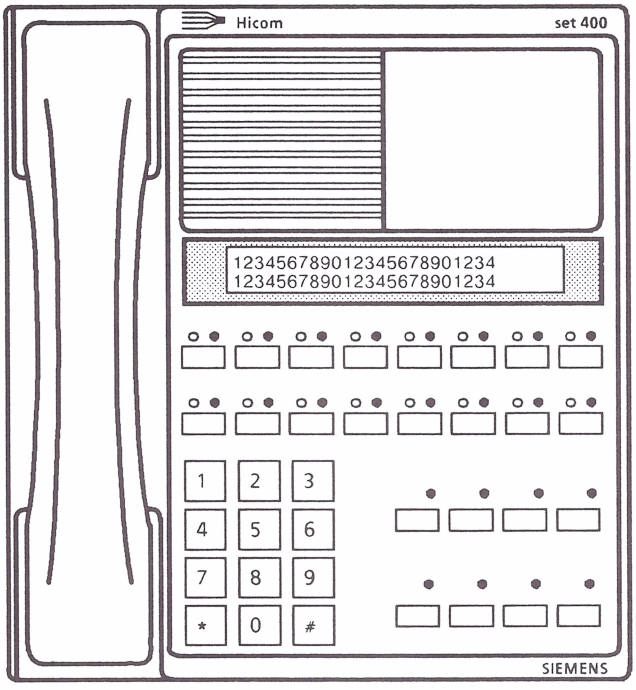


Fig. 6-6: Feature Telephone
Hicom set 421 T24 FD

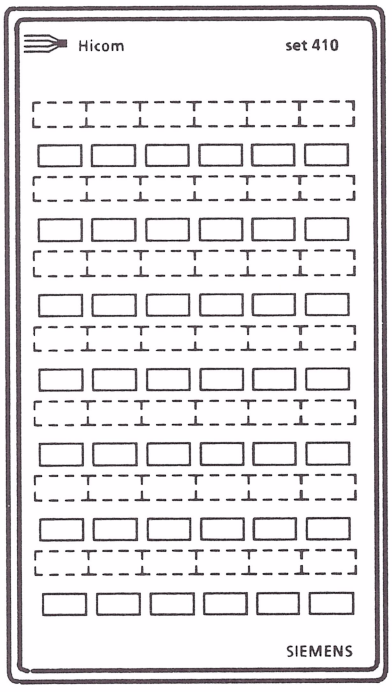


Fig. 6-7: Auxiliary unit
Hicom set 410 N

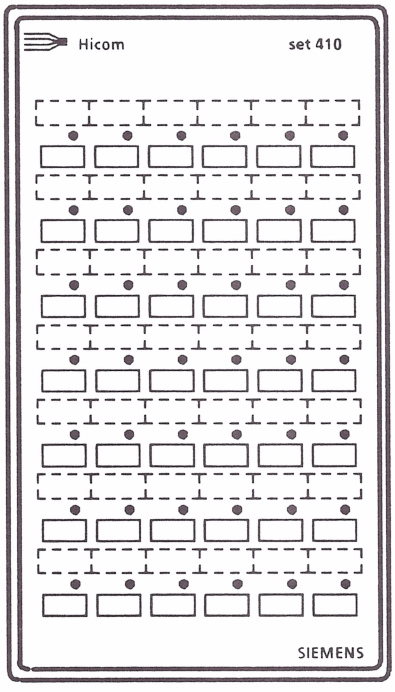


Fig. 6-8: Auxiliary unit
Hicom set 410 T

Hicom set 451 T8
Feature Telephone

- Feature and status information by means of LED (red)
- 8 feature keys (4 with LEDs); incl. 1 programmable as feature, repertory or DSS key
- Electronic volume and tone control by way of 2 keys
- Open listening
- On-hook dialing

Hicom set 451 T24 D
Feature Telephone

- Feature and status information by means of LED (red) and display
- Convenient operating and programming procedures, user prompting via display
- Display 2 rowa/24 characters
- 24 feature keys, 8 with LEDs; incl. 17 programmable as feature, repertory or DSS* keys
- Electronic volume and tone control by way of 2 keys
- Open listening
- On-hook dialing

Hicom set 451 T25 FD
Feature Telephone

- Feature and status information by means of LED (red) and display
- Convenient operating and programming procedures, user prompting via display
- 2 rows/24 characters
- 25 feature keys (21 with LEDs); incl. 14 programmable as feature, repertory or DSS keys
- Integrated handsfree talking, open listening, on-hook dialing
- Addit. power feeding possible
- Opt.: integration of interface multi-plier for connection of desk microphone , extra earphone, second ringing unit, etc.
- Extras:
  * Auxiliary unit with 29 feature/ repertory keys
  * Variant thereof with integr. chip card reader

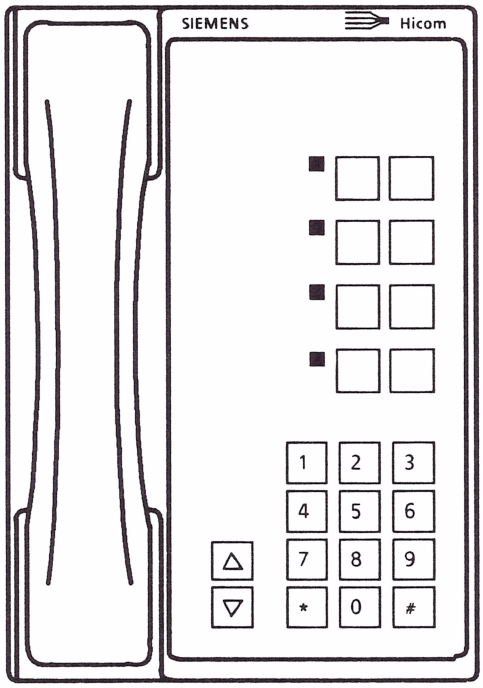


Fig 6-9: Feature Telephone
Hicom set 451 T8

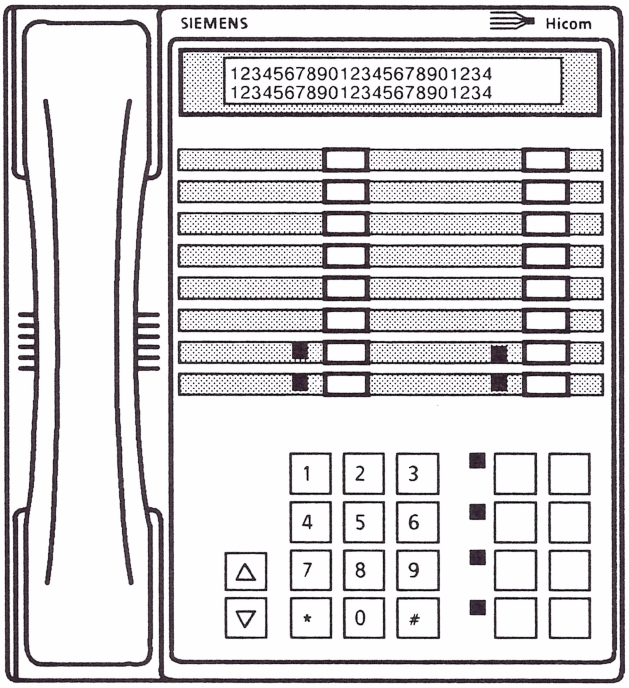


Fig 6-10: Feature Telephone
Hicom set 451 T24 D

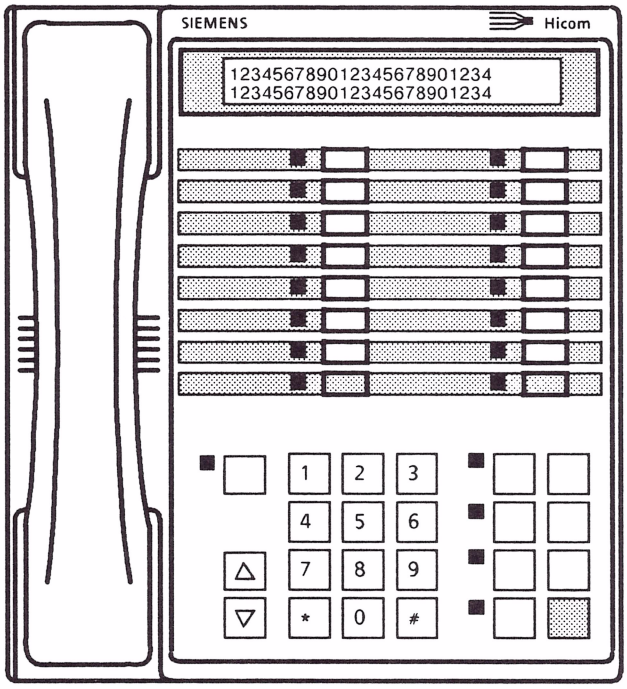


Fig 6-11: Feature Telephone
Hicom set 451 T25 FD

Hicom set 521 T25 FD
Feature Telephone

Features:
- Digital feature telephone for voice and data
- ISDN features by means of mixed-mode and multiple communication
- Feature and status information by means of LED (red) and display
- Convenient operating and programming procedures, user prompting via display
- 25 feature keys (21 with LEDs); programmable as feature, repertory or DSS keys
- Display mit 2 rows x 24 characters
- Integrated handsfree talking, open listening, on-hook dialing
- Addit. power feeding possible
- Opt.:
  * integration of S_0 adapter (PNT 520)
  * integration of V.24 adapter (DCI 521) with autom. dialing method based on Hayes and V.25bis, bit rate adaption system
    DMI M2, asynchronous data transmission up to 19.2 KB
- Extras:
  * Auxiliary unit with 29 feature/ repertory keys
  * Variant thereof with integr. chip card reader

Hicom set 721 T25 FD
Feature Telephone

Features:
- Digital feature telephone for voice and data
- ISDN features by means of mixed-mode and multiple communication
- Feature and status information by means of LED (red) and display
- Convenient operating and programming procedures, user prompting via display
- 25 feature keys (21 with LEDs); programmable as feature, repertory or DSS keys
- Display 2 rows x 24 characters
- Addit. power feeding possible
- Integrated handsfree talking, open listening, on-hook dialing
- Opt.:
  * integration of V.24 adapter (DCI 521) with autom. dialing method based on Hayes and V.25bis, bit rate adaption system
    DMI M2, asynchronous data transmission up to 19.2 KB
- Extras:
  * Auxiliary unit with 29 feature/ repertory keys
  * Variant thereof with integr. chip card reader

Hicom set T29
Auxiliary unit

- 29 keys with LEDs
  for repertory, feature and DSS key expansion
- Connection to:
  set 451 T25 FD
  set 521 T25 FD
  set 721 T25 FD

Hicom set T29 K
Auxiliary unit

- 29 keys with LEDs
  for repertory, feature and DSS key expansion
- Integrated chip card reader
  1 LED for status information
- Connection to:
  set 451 T25 FD
  set 521 T25 FD
  set 721 T25 FD

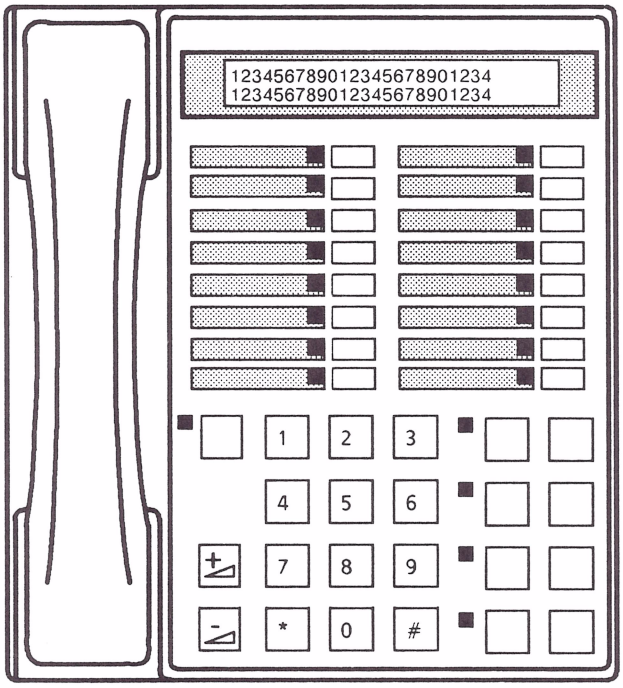


Fig. 6-12: Feature Telephone
Hicom set 521 T25 FD

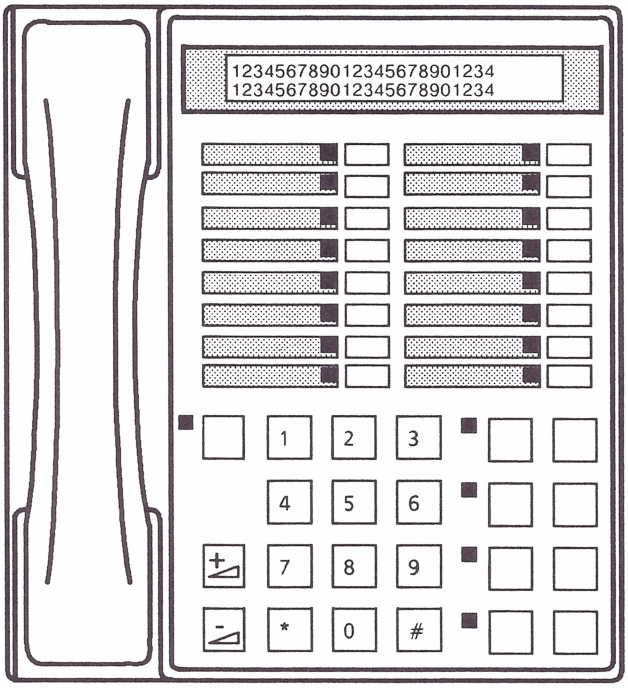


Fig. 6-13: Feature Telephone
Hicom set 721 T25 FD

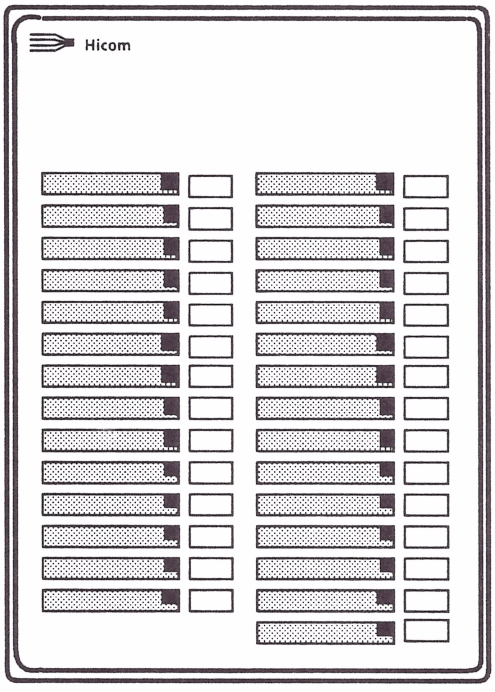


Fig. 6-14: Auxiliary unit
Hicom set T29

6.4 Hicom MT 3510 Multiterminal

The Hicom MT 3510 Multiterminal, consisting of MT 3510 and S 3510, combines the different services and provides the user with mixed-mode communication. The functions of the MT 3510 and S 3510 are divided up as follows:

MT 3510

Communication:
- telephony as for Hicom set 260 feature telephone
- display copy
- videotex
- access to text communication
- access to data communication
- access to loading and saving services

Local functions:
- text editor (as memory typewriter)
- name directory
- local printing

S 3510

Central services
- text communication
  electronic mail
  filing
  central printing
- data communication
  9750 emulation
  3270 emulation
- loading services
  initial program loading
  loading/saving personal data

MT 3510 comprises:

- control unit with 12" monochrome monitors
  - printer connection
  - connection for videotex color monitor
  - connection for second keyboard
  - handsfree equipment
  - chip card reader
- MT 3510 compact keyboard (detached)
  - control and display panel
  - voice terminal section
    * 20 feature keys with LEDs
    * 12-key pushbutton set
    * display line
  - text/data section
    * feature key panel
    * alphanumeric keyboard
- handset with rest
- matrix printer (optional)
- "professional" text/data keyboard (optional, suppl. to T3510 keyboard)

S 3510 comprises:

- Basic version:
  - 1 basic unit with processor,
    * main memory
    * 1 disk drive,
    * 1 disk controller,
    * 1 monitor as service terminal
  - 1 connecting unit for monitor
  - 1 keyboard
  - 1 hard disk
  - 1 U* interface (2nd interface optional)
- For the central printing service the following are also required:
  - 1 printer
  - 1 printer connection unit
- A data transmission interface is also required for the data communication services: either MSV 1/BSC (Transdata) or HDLC/SDLC (SNA).

Fig. 6-15: Hicom 3510 Multiterminal

User identification for all services usually takes the form of input of a personal I.D. number or insertion of the chip card.

Access to personal data in the terminal is protected by means of a password.

7 Technical data - overview

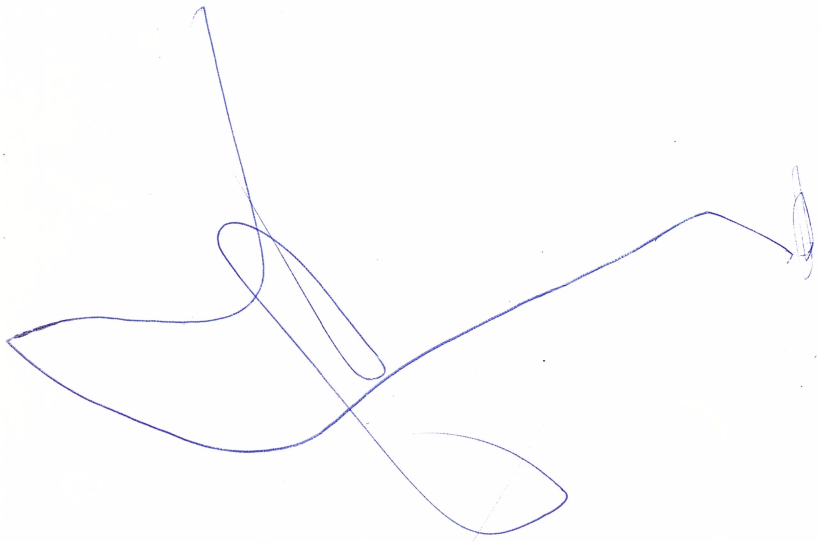
System	Stored program control (SPC)	
Coding	PCM, A-Law as per CCITT G.711	
Switching network	digital time division multiplex for 64-kbit/s single channels	
Depending on the number of ports connected, the Hicom 300 communication system is subdivided into three capacity stages:		
	Hicom 300 comprising ≤256 ports Hicom 300 comprising ≤960 ports Hicom 300 comprising ≤5120ports	
Static traffic values	from 0.4 erl/port (Hicom 300 with ≤5120 ports) to 1 erl/port (Hicom 300 with ≤760 ports)	
Dynamic traffic values	from 11700 BHCA (Hicom 300 with ≤960 ports, DPML) to 36000 BHCA (Hicom 300 with ≤5120 ports, DP386)	
User terminal equipment	Analog telephones using dial pulsing and grounding key as control key, or DTMF telephones with flash or grounding key. Feature telephones Terminals for facsimile Terminals for teletex Terminals for videotex Terminals for data Terminals for voice and videotex Hicom MT 3510 Multiterminal for voice, text, videotex and data	
Transmission values, tones and signals	As per CCITT and current German PTT stipulations	
Power supply	Nominal voltage	–48 V
	Power consumption	2 to 3 W per user terminal
Ambient conditions	Relative humidity	20 – 80 % (limit value excl. condensation)
	Operating temperature	+ 10 °C to + 40 °C (limit values) Cooling by means of natural convection
Optimum operating conditions	Relative humidity	20 – 70 %
	Operating temperature	+ 16 °C to + 32 °C
Cabinet types	Basic cabinet (Hicom 300 with ≤256 ports) Basic cabinet (Hicom 300 with ≤960 ports) Expansion cabinet (Hicom 300 with ≤960 ports) Power supply and MDF cabinet (Hicom 300 with ≤960 ports) Server cabinet (Hicom 300) Control cabinet (Hicom 300 with ≤5120 ports) Peripheral equipment cabinet (Hicom 300 with ≤5120 ports) MDF cabinet (Hicom 300 with ≤5120 ports) Device cabinet (Hicom 300 with ≤5120 ports)	
Cabinet dimensions H x W x D	Hicom 300 with≤256 Ports 1895×1020×500mm	Hicom 300 18959×770×500 mm
Weight according to capacity	approx. 300 kg	approx. 220 kg per cabinet

For detailed technical data see "Hicom 300, Features, Data, Interfaces",
Ordering no. A30951-A1000-A101-*-7629

8 Abbreviations

AC	Hicom Attendant Console
ADS	Administration and Data Service
ALS	Advanced Low Power Schottky Technology
AMO	Administration and Maintenance Operation
ANSI	American National Standards Institute
AS	User System
BGR	Shelf
BSC	Binary Synchronous Communication
BT	Service Terminal (Administration and Maintenance Terminal)
Btx	Videotex
CAB	Cabinet
CC	Common Control
CCG	Central Clock Generator
CCITT	Comité Consultatif International Télégraphique et Téléphonique
CMS	Communication Management System
CO	Central Office
CONF	Conference Unit
CP	Call Processing
CR	Clock Repeater
CSN	Central Switching Network
CTE	Circuit Termination Equipment
DCI	Data Communications Interface
DCL	Data Communication Link
DH	Device Handler
DMS	Data Management System
DP	Data Processor
DTE	Data Terminal Equipment
DTMF	Dual Tone Multifrequency Signaling System
Fax	Facsimile
FCD	Facsimile Control Digital
GSN	Group Switching Network
HDLC	High Level Data Link Control
HKZ	Main Station Interface
HW	Hardware
IDN	Integrated Data Network
IHS	Integrated Hicom Server
IKZ	Pulse Signaling System
IOCC	Input Output Control Central
IOCG	Input Output Control Group
IOPS	Input/Output Processor
IP	Interface Processor
ISDN	Integrated Services Digital Network
ISO	Intern. Organization for Standardization
IWV	Dial Pulsing

LBC	Line Bus Controller
LCC	Line Circuit Control
LCR	Line Controller R
LCU	Line Controller Universal
LGG	Charging Rectifier Unit
LTG	Line Trunk Group
LTGC	Line Trunk Group Control
LTU	Line Trunk Unit
LTUC	Line Trunk Unit Control
LTUS	Line Trunk Unit Shelf
MAC	Maintenance and Alarm Control
MAP	Maintenance and Alarm Panel
MBU	Message Buffer Unit
MD	Message Distributor
MDF	Main Distribution Frame
MEM	Memory
MML	Man Machine Language
MSV1	Middle Speed Version 1
MTS	Memory Time Switch
NMC	Network Management Center
PBC	Peripheral Board Controller
PC	Personal Computer
PCM	Pulse Code Modulation
PCG	Peripheral Clock Generator
PNT	Private Network Termination
PP	Peripheral Processing
RAX	Rate Adapter X
RMS	Remote Switch
SCSI	Small Computer System Interface
SDLC	Synchronous Data Link Control
SIU	Signaling Unit
SM-CC	Server Common Control
SN	Switching Network
SU	Service Unit
SW	Software
SWU	Switching Unit
TCS	Tele Communications Service
TFS	Text Fax Service
Ttx	Teletex
VCD	Voice Compression Digital
VMS	Voice Mail Service
Vtx	Videotex



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